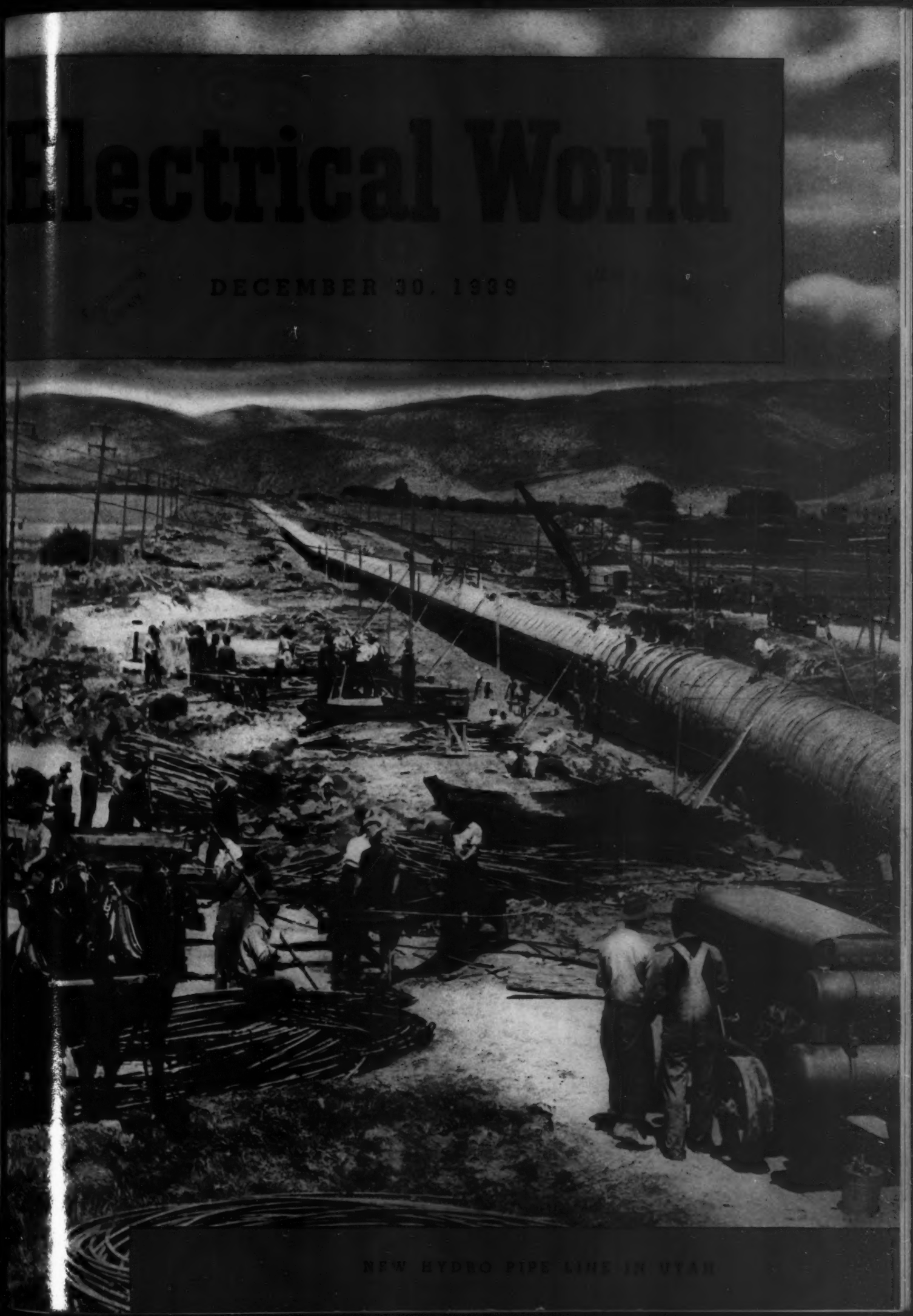
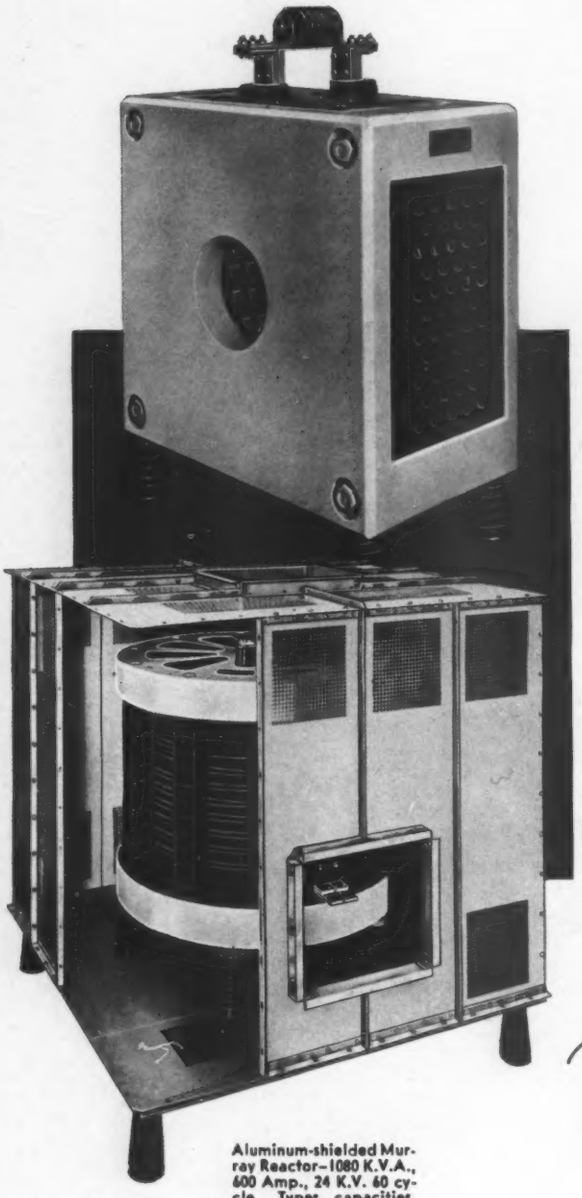
Electrical World

DECEMBER 30, 1939



NEW HYDRO PIPE LINE IN UTAH

A THRIFT MESSAGE TO UTILITIES WHICH CAN USE A BIT MORE MONEY!



Aluminum-shielded Murray Reactor—1080 K.V.A., 600 Amp., 24 K.V. 60 cycle. Types, capacities, sizes for every purpose.

Above: Single-phase Indoor Dry Type Reactor.

YOU who installed Murray Reactors years ago have told us time and again what a fine protective job they've been doing—and they'll keep right on doing it, reliable as ever.

But Murray Reactor design has moved forward with motor cars, trains and ships. Murray Reactors are better now than ever before. But *fundamentals* remain unchanged. That is why Murray can modernize your old reactors (Murray only)—make them better, thriftier to operate—at a fraction of the cost of new ones.

There's extra cash that any power company can use to good advantage today. Ask us about this. No cost! Metropolitan Device Corporation, Brooklyn, New York.

modernize YOUR OLD **Murray**

LOW-LOSS REACTORS *for operating savings*

1940

As one year ends and another starts there is always the temptation to make prognostications. To project ahead today for twelve months is fraught with too much danger. There are so many "ifs," "ands" and "buts" that one hesitates to make a specific answer.

At the moment, although the immediate future seems to indicate some recession from the strong fall buying movement, the consensus seems to be that 1940, barring extraordinary unforeseen events, will show a conservative upturn in business. The signs for the year, in other words, are healthy.

This much can be said, however, that whatever the increase is in general business it will be better in the electric utility business. This is predicated on two things: One, the resumption of industrial activity will continue to bring an increasing demand for mechanization and, therefore, more load. Second, there will be an accelerated increase in new capacity which will require accelerated load building.

Next year, if present plans are carried out, will see the largest utility construction program of any year since 1930. Preliminary figures indicate that the construction budget for 1940 is in the neighborhood of 600 millions.

Not everything is rosy, however, for, mixed with the problems of expansion, there are going to come difficulties of a political nature. Those which can be seen at the moment probably have some connection with elections. In fact, the public power block has indicated that power will be an issue in 1940.

There is the matter of interconnection and of generating capacity. It is admitted in administrative circles that there is no impending power shortage, nor any immediate concern about the preparedness of power for national defense. Nevertheless, utilities are asked to bring their construction schedules forward. With a reduction in public works spending, accelerated utility spending will take up slack in employment.

Application of the utility act with respect to integration appears to be closer to actuality than ever before. Barring legal action, it appears likely that there may be several changes in utility control during the year.

With respect to federal power, there is reason to believe that the year may bring further co-operation between power authorities and private companies. The practice of having private companies distribute government power is growing. On the other hand, there appears to be a trend toward state power authorities, which in turn may create still more publicly owned hydro power. This may be expected to be even more pronounced next year.

There will be some who will view the problems of the year with considerable alarm, but, with some exceptions, it must be admitted that in the past our fears have exceeded the consequences. This may be true of next year. For the most part the problems will be aggravating, but the solutions may in the long run bring a stronger industry.

Balancing everything, therefore, we foresee and wish the industry a Prosperous and a Happy New Year!

Electric Systems Benefit From Modern Weather Forecasting

Lately defined principles of movements of air masses make possible accurate weather predictions a day or more ahead, thus allowing time to organize service protection measures

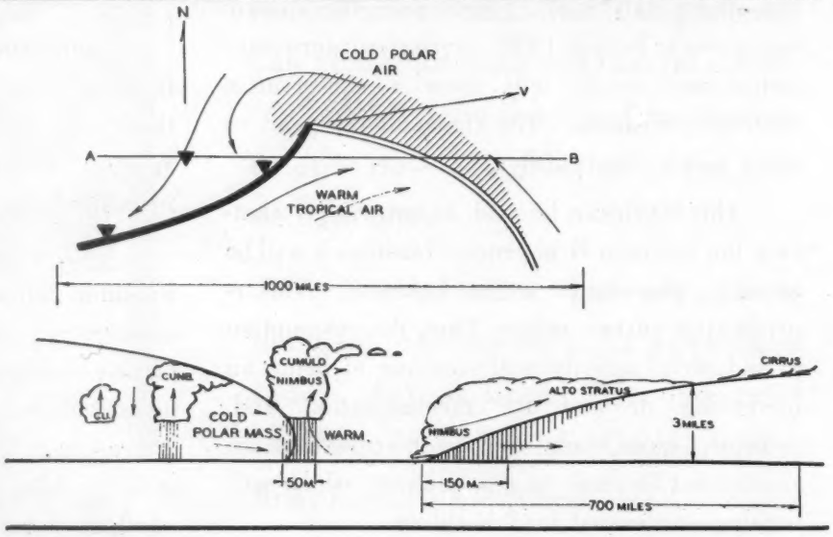
IRVING P. KRICK,* ***Pasadena, Calif.***

RECENT developments in the science of meteorology have amplified the importance of accurate weather predictions to industry. More precise methods of weather analysis now make it possible to supply industries with weather prognostications of a specialized and interpretive nature which enable the utility operator, the motion-picture producer, manufacturer, wholesaler or farmer to obtain a foreknowledge of weather factors pertaining to his own peculiar operating problems. In this manner he is enabled to prepare in some measure for future weather influences.

One of the prime requirements for efficient operation of an electric power supply system is continuity of service. Certain weather developments tend to jeopardize this continuity by either damaging poles, lines, transformers, etc., or otherwise causing outages that require considerable time to repair. The chief weather elements in this category include lightning storms, high winds and the accumulation of ice and wet snow on conductors. Due to the fact that these phenomena are frequently highly localized, some operators have felt that they were unpredictable. It is quite true that a technique of weather prediction capable of coping with these problems is of rather recent origin.

At the present time, however, it is possible to estimate both the extent and duration of these phenomena with a high enough accuracy to warrant at least calling it to the attention of the industry. In the past, needless expense has been incurred by either calling crews because weather conditions "looked bad" and nothing serious developed or, in frequent instances, maintaining crews on overtime long after the danger of any critical weather developments had passed. An accurate foreknowledge of storm developments and their termination now makes it possible to provide just the proper number of men to meet the situation and thus to minimize repair costs as well as losses in revenue resulting from outages.

At this point it seems appropriate to discuss in some detail one type of prediction which might be termed



The fundamental principle

The basis of modern weather analysis is the fact that the storms of middle latitudes are the results of a continuous conflict between cold polar air and warm tropical air along their boundary of separation. The less dense warm currents are obliged to pass aloft over the colder currents, thus producing clouds and precipitation. Here is an idealized diagram of a typical disturbance along such a surface of separation. The upper figure is a horizontal projection showing a warm tropical current moving northeastward, separated from a cold polar air current out of the north. On the east side of the disturbance the warm air is forced aloft over the polar current, producing a zone of precipitation, which is indicated by the hatched area. On the western side of the disturbance the cold polar current is pushing southward, displacing the warm current. Along the forward edge of the intruding cold mass a zone of showers and squalls is typical. A vertical cross-section along the line A-B is shown in the lower part of the drawing. On the right-hand side the warm current may be seen passing aloft over the wedge of cold polar air. Its vertical motion gives rise to an extensive cloud mass, from which comes precipitation. On the left-hand side of the drawing a cross-section of the intruding polar wedge is shown with rather violent vertical motions in the immediate vicinity of the boundary separating the two currents. This action is producing a narrow band of dense cloud and from this precipitation comes also. Frequently the southward movement of the cold polar air into warmer latitudes causes enough heating of the surface layers to produce local ascending currents of air, which, in turn, cause isolated clouds and showers. This is illustrated by a shower in the cold polar mass in the left-hand portion of the lower figure.

*Associate professor of meteorology, California Institute of Technology.

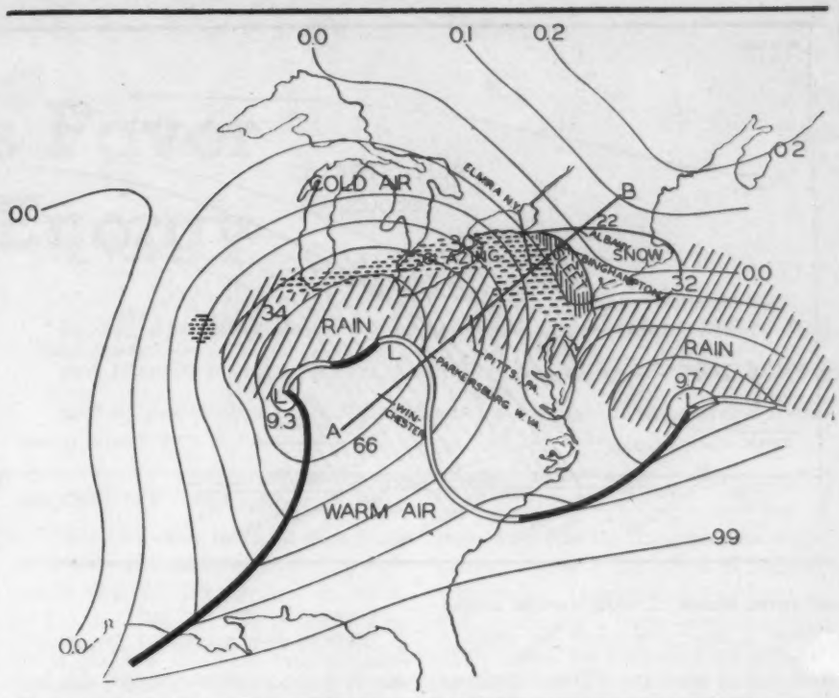
"emergency service." During the winter season the accumulation of ice and wet snow on conductors leads to frequent outages due to the shorting of conductors or actual breaks in the lines. In a recent publication Langdon and Marquis[1] conclude, after describing their method for detecting the presence of ice on conductors and the use of heat to melt it, that the one element lacking in the procedure for minimizing breakdowns due to this type of loading is a reliable prediction of the phenomenon. They point out that it would be very helpful to the operator to be forewarned not only of the amount of ice which might accumulate on conductors but the duration of such a storm. Considerable preparation is necessary for loading conductors to the point where their temperature will be high enough to melt or prevent ice formation, and if the glaze deposit is small, this procedure may be unwarranted and involve unnecessary expense.

In an effort to supply this type of information to the electric utility industry the writer was authorized to provide forecasts of glazing during the winter of 1938–39 to a large eastern company. In one instance it was possible to notify the company of an impending ice storm two days before it arrived. As it happened, this development occurred on a Sunday, and since it was one of the most severe ice storms in the history of the community it would have caused far more trouble had it been unheralded.[2]

Lightning Storm Warnings

In the summer time an emergency forecasting service is primarily concerned with the prediction of lightning storms. For this type of work it has been found necessary to maintain close contact between the weather forecasting center and the operators' headquarters throughout the 24 hours of the day. This is usually accomplished by the use of teletype connections and in this way several hours' warning on even highly localized lightning storms can be issued. Not only must the probable time of occurrence of lightning storms be anticipated, but also the character of the storm indicated. Often a lightning storm appears to be "hot," but a study of the meteorological conditions producing it may disclose the fact that it is a high level phenomenon with a large percentage of strikes from cloud to cloud and not to ground.

Again, short-lived but intense lightning storms causing many strikes as well as blowdowns often occur with little or no warning, especially in the spring and fall. The time of occurrence of these most damaging types may be predicted quite accurately, and frequently the time of clearing may be indicated very closely so that supplementary crews need not remain on duty a moment longer than necessary. Both of these storm types are associated with the development of disturbances along the boundaries of separation of warm and cold currents as described in the accompanying illustrations and captions. In the summer time the structure of the warm

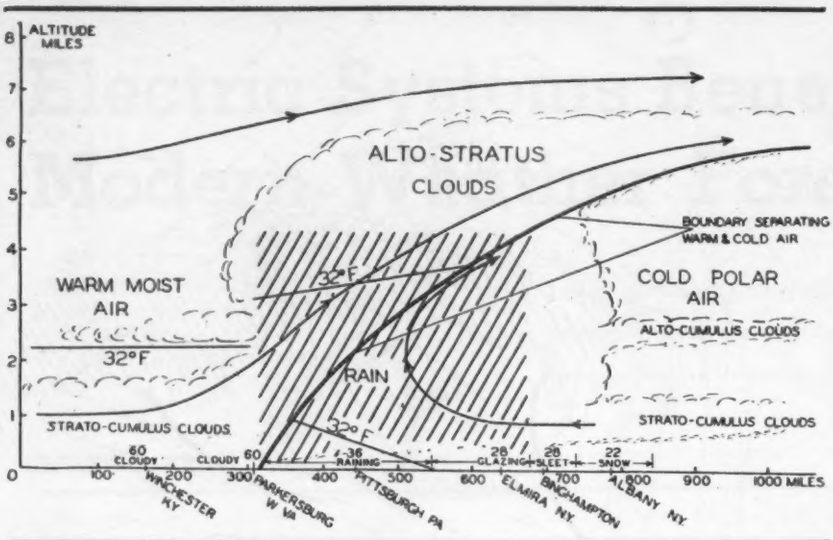


Ice storm, March 12, 1939, horizontal section

In the spring of the year the extensive sleet and ice storms in the eastern part of the country are the result of the over-running of cold Canadian air currents by warm, moist air masses moving northward from the Gulf of Mexico. Frequently the temperature of the rain droplets falling from the warm tropical current through the cold polar air reaches a value below the freezing point without solidification taking place until the droplet strikes an object. The agitation thus produced causes the crystallization process to occur and results in an accumulation of ice on the object if its temperature is below freezing. However, if the temperatures of the ground, trees or transmission lines are above freezing, sufficient heat is available to prevent ice formation. This explains the fact that conductors heated to a temperature above freezing will not accumulate ice, even though objects in the vicinity at temperatures below freezing may become heavily loaded. When these conditions appear on a weather chart the forecaster, through a knowledge of temperatures at the surface and aloft, can prepare quite an accurate prediction of both the intensity and duration of such storms.

This is a horizontal cross-section showing weather conditions in the eastern half of the United States on the morning of March 12. It will be noted that a boundary of separation is drawn between cold air to the north and warm air over the southern part of the country. The portions of this surface where warm air is sliding aloft over the colder current are shown by a double line, and sections where the cold air is pushing southward into the warm current by a heavy, solid line. The precipitation areas to the north of the boundary have been broken down into those of rain, glaze, sleet and snow. In the rain areas temperatures are above freezing at the earth's surface; in the glaze areas they are slightly below freezing, while in the sleet and snow areas they are well below freezing. An examination of the figure will show that glaze is confined to a rather narrow belt extending from the vicinity of lower Lake Michigan eastward through southern Michigan and southern Ontario, becoming more extensive through western New York and the Appalachian Mountain areas. From a determination of the movement of the storm areas involved, and the resulting temperature changes, the forecaster may determine regions where glaze will develop. In this particular instance the storm center south of Michigan moved almost directly eastward and ice formation continued in southern Michigan for about 24 to 36 hours, resulting in a very heavy accumulation. A vertical section of this storm, line A-B, appears on the next page.

[1]Langdon and Marquis, "Carrier Attenuation Discloses Glaze Formation," "Electrical World," August 12, 1939.
[2]Detroit Edison *Synchroscope*, April, 1939.



Ice storm, March 12, 1939, vertical section

Here is shown the upper air structure producing the storm. This is a vertical cross-section along the line A-B of the horizontal diagram. Winchester, Ky., lies in the warm current and the state of weather and temperature at map time are indicated on the drawing, namely, cloudy, with a temperature of 60 deg. F. At Parkersburg, W. Va., very close to the boundary of separation between the two currents, conditions are the same. At Pittsburgh, Pa., which lies well within the cold current, it is raining, with a temperature of 36 deg. F. At Elmira, N. Y., however, the temperature is 28 deg. F. and the rain is freezing to form glaze. At Binghamton, N. Y., the rain is falling through a sufficient thickness of the cold polar current to freeze it before reaching the ground, producing sleet, and finally, at Abany, N. Y., the over-running air current is at a temperature so far below freezing that all of the precipitation is in the form of snow. The cloud system produced by the over-running warm, moist current and the zone where rain is developing is shown. Temperatures in the free air at the freezing level are shown in both the warm air current and the underlying cold mass. The construction of a vertical cross-section of this character is made possible through the use of upper air and surface observations taken simultaneously, a daily practice at many U. S. Weather Bureau stations throughout the country.

air currents in the eastern part of the country favors the genesis of lightning storms.

Unfortunately, one type of summer lightning storm is very difficult to predict in more than a general way, and often a number of such storms will distribute themselves randomly throughout the operator's system area. These developments are infrequent, but in such cases predictions can be accurate in a statistical way and may be counted on to produce economy of operation when considered over a long period of time.

There are several other weather elements which are of interest to the electric utility industry which are of a less spectacular nature than those described above, but equally important from an operating standpoint. In the field of hydroelectric generation the prediction of the character, intensity and duration of precipitation for both short and long periods is extremely valuable in planning and estimating monthly production. Although forecasts covering a week and even a month are necessarily less accurate and detailed than those for only a day or two, their utility has already been strikingly demonstrated, considering the fact that the technique employed is a relatively new development.[3]

For Scheduling Hydro Plants

Several large companies maintaining extensive hydro-electric facilities are using the writer's predictions of daily, weekly and monthly precipitation for various watersheds in which they operate to aid them in effectively planning their water conservation and utility. When dry periods are predicted all available water is of course impounded, while in anticipation of heavy rains or even flood conditions steam plants are shut down and the operation of dams and reservoirs planned to minimize the danger of damage to property or even loss of human life.

[3]Irving P. Krick, "A Technique for the Preparation of Monthly Weather Predictions." Memoirs of the International Union of Geophysics of the International Congress, Washington, D. C., September, 1939.

The savings in this field alone through the judicious use of reliable weather predictions can be very large. It has been estimated by one operator that the shut-down of one steam plant for one day on the basis of an accurate forecast more than liquidates the expense involved in maintaining the forecasting service for a year.

At the present writing drought conditions in the southeastern portion of the country have reached a point where considerable steam generation is necessary to meet the increasing demands of industry on the power companies. Obviously the prediction of the first substantial rains will enable operators to discontinue the operation of generating plants of higher production cost and to draw on reserves for the generation of hydro-electric power. Thus substantial savings in the cost of production may be accomplished without fear of depleting water now impounded.

Another phase in the operation of an electric power company where predictions can be of value is in estimating heating, electric lighting and air-conditioning loads during periods of rapidly changing temperature, humidity and cloudiness. When anticipating heating loads forecasts of mean temperature which may be converted into degree-days are quite useful. It is possible to determine this quantity with an accuracy greater than the differences occurring in various sections of a city. The prediction of a single element embodying temperature and humidity, called the "equivalent" temperature, forms a useful criterion for estimating the air-conditioning load during warm, muggy summer weather. A foreknowledge of the degree of darkness of clouds and their duration has been found valuable in estimating variations in electric lighting loads. These latter forecasts have been developed to a high degree of accuracy from methods utilized by the writer in determining light conditions and the photographic value of a day for the motion-picture industry.

Supplemental to Weather Bureau

Thanks to the fact that weather information from the entire world, if need be, may be assembled quickly at one location through the use of modern communication facilities, it was felt that a forecasting unit could be established at some point within

[*Continued on page 79*]

Cost Trends Favor Purchased Energy

In the operating costs of an isolated power plant labor, fuel and taxes are large factors, and they are all on the rise, but the cost of purchased power maintains its consistent downward trend

THE ELECTRICAL WORLD of August 31, 1935 (page 64), contained a chart showing the price trend of several different important items which go into the making of power over the period of 1932–1934 inclusive. In the article accompanying the chart it was pointed out that the competitive position of purchased energy had become much stronger because the price of electricity was steadily declining, in contrast with the rising cost of important items involved in the operation of power plants.

The chart has now been extended to cover the period of 1932–1938. It shows a continuation of the trends noted in the earlier period. Everything went up except the price of electricity. Wages of employees in electric light and power and gas plants averaged 66.7 cents per hour in 1932, 75.2 cents in 1934, 84.3 cents in 1938. Bituminous coal (run-of-mine) cost $3.638 per ton in 1932, $4.131 in 1934, $4.327 in 1938. For the same years the price of Oklahoma fuel oil was successively 42.8 cents, 73.6 cents and 91.4 cents per barrel.

Sharpest of all was the increase in the receipts of the federal government, representing essentially money raised by taxation in one form or another. These receipts amounted to $2,005,725,000 in 1932. Two years later they had risen to $3,115,554,000; in 1938 they were $5,992,733,000. Reduced to a per capita basis, these are equal, respectively, to $16, $24.60 and $46.

In contrast the price of electricity fell from 2.25 cents per kilowatt-hour in 1932 to 2.01 cents in 1934 and to $1.72 cents in 1937. In 1938 there was a moderate increase to 1.837 cents, reflecting the effect of reduced wholesale (low-priced industrial) energy during a large portion of that year, but even with that setback the average was 19 per cent lower than in 1932.

The statistics here plotted have been taken exclusively from publications of the federal government. Wages are for the electric light and power and gas industries as reported monthly by the Bureau of Labor Statistics, beginning with October, 1932. For the first nine months of that year they were worked backward on the basis of index numbers of per capita earnings and are, therefore, only approximations.

Costs of Oklahoma fuel and run-of-mine bituminous coal are wholesale

[*Continued on page 83*]

Purchased energy costs decline, other power costs rise

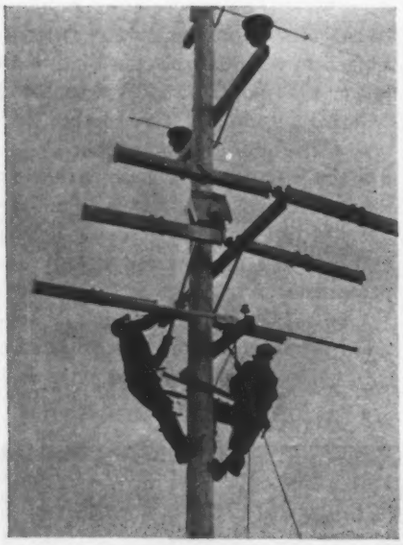
Wood for Hot Line Protection

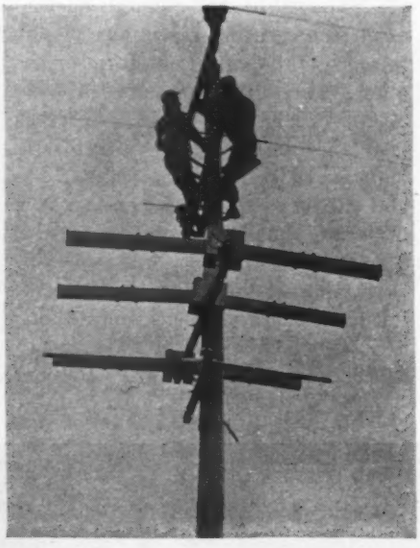
Obviates necessity for killing circuits lower down on pole when working on line at top — Rubber is not adequate protection on bottom lines of fairly high voltage, but wood is

R. M. RUTH, *Northern States Power Company, Eau Claire, Wis.**

FOR USUAL distribution voltages rubber coverings—blankets, hose and insulator hoods—are sufficient to protect linemen from accidental contact with energized lines while working in pole tops. But in transmission line work, where the linemen may have to climb or stand between conductors of voltages 6,900 to 15,000 and higher in order to work, perhaps with live line tools, on a circuit higher up on the pole, rubber does not afford a good enough protection. For this reason it has been usual practice to de-energize the circuit or circuits lower down on the pole while work is being done on the conductors higher up.

*Adapted from paper to Wisconsin Utilities Association.



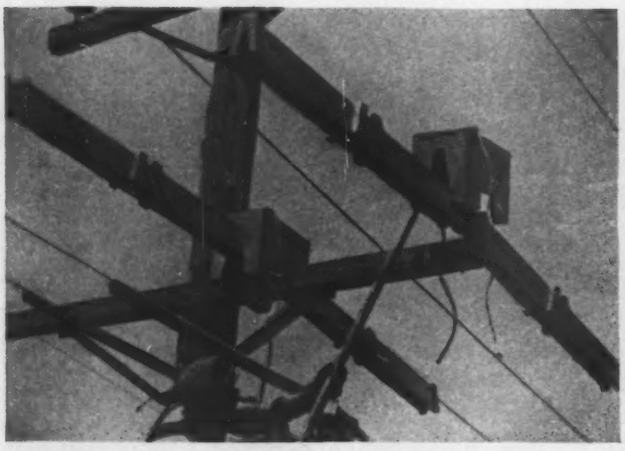


Installing wooden protectors on 13.2-kv. circuit preparatory to insulator change on high-voltage circuit above

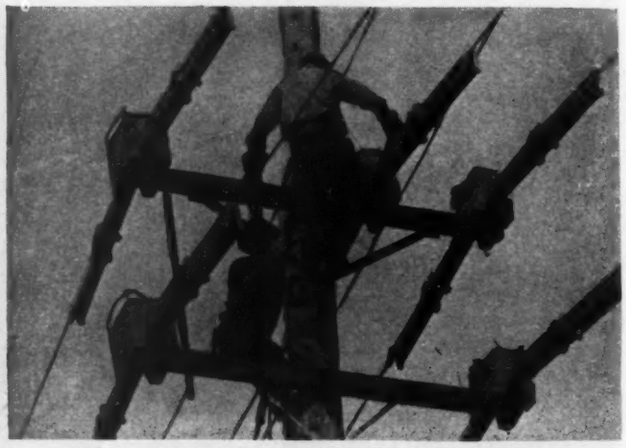
Much thought has been given to the devising of means for covering up the lower conductors on transmission poles so that the linemen can pass or stand safely among them, thus to obviate the necessity for taking two or three circuits out of service in order to work on one. A locally developed means for providing this protection for voltages 6,900 to 22 kv. is working out very well on the system of the Northern States Power Company. The protection consists of a pair of inverted wood troughs set over the wires each way from the insulator in combination with an open wood box which covers the insulator and holds the troughs in place. The scheme is clearly apparent from the accompanying illustration.

The material used is redwood. This was chosen after many experiments and tests as being the best, combining lightness, strength and insulating quality. Each trough is sawed from

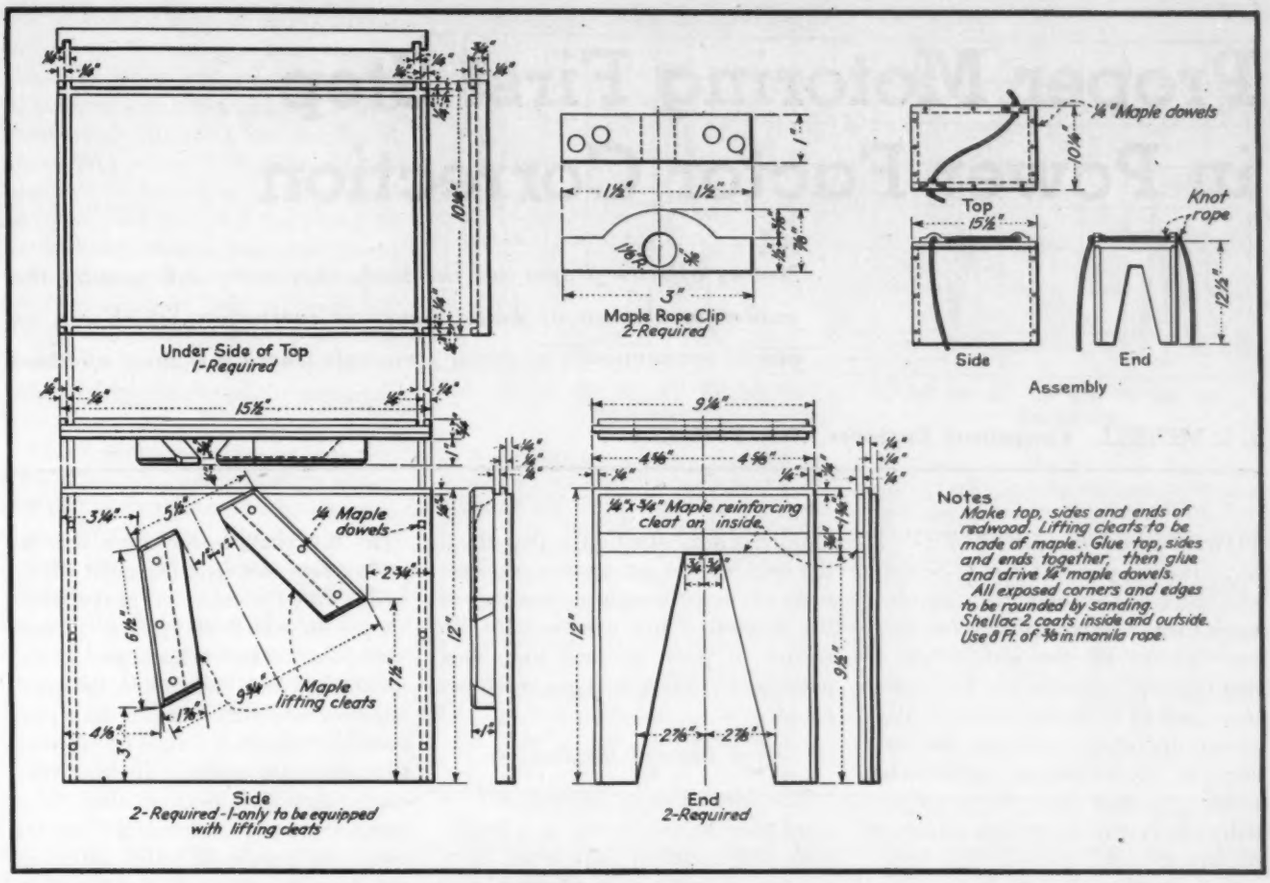
[*Continued on page 831*



Troughs and boxes installed with a spade-like tool that engages with cleats on side—rubber gloves not necessary

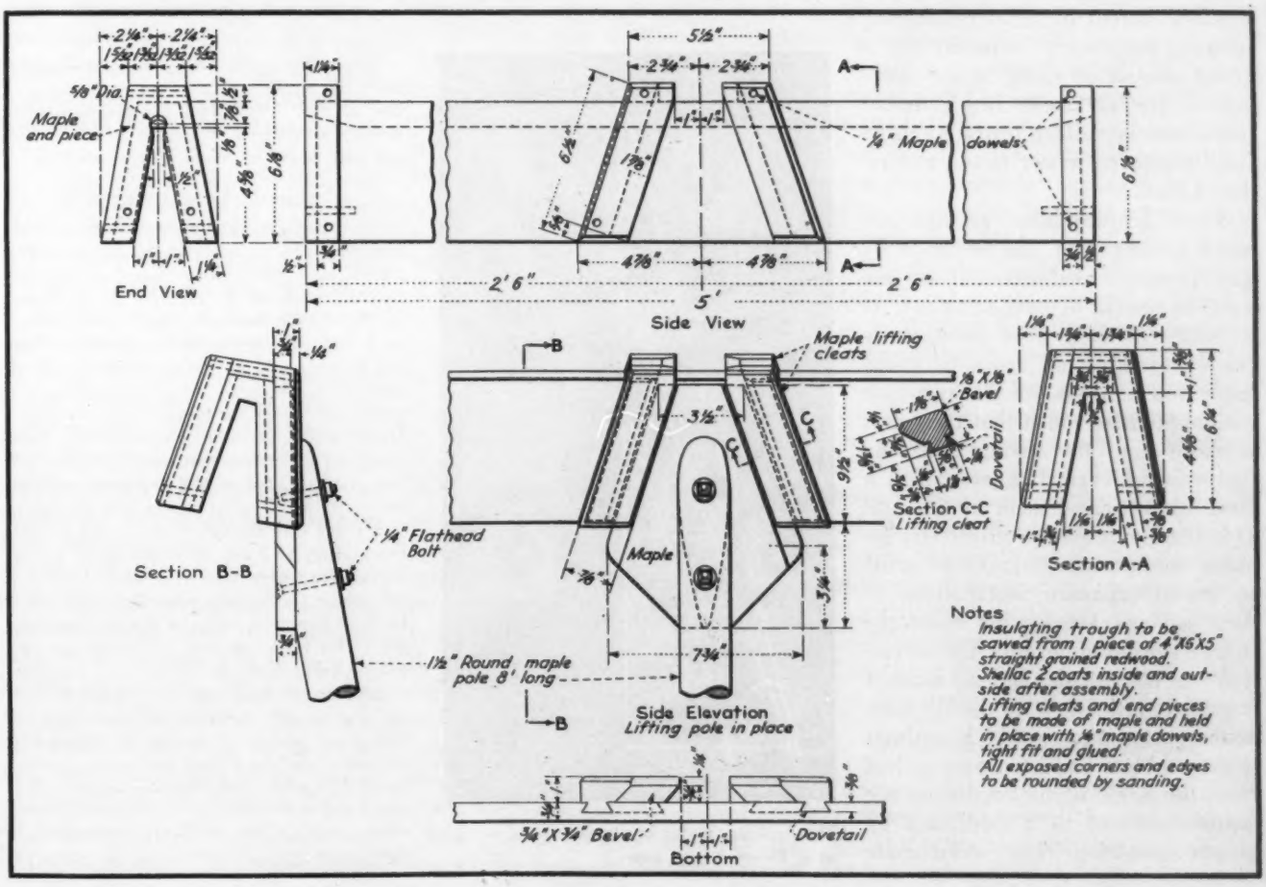


Lineman climbs through 6,900-volt circuits to reach 13-kv. circuit above. Note hand on trough


Under Side of Top
1-Required
Maple Rope Clip
2-Required
⅛" Maple dowels
Top
Knot rope
Side
End
Assembly
¼ Maple dowels
Maple lifting cleats
Side
2-Required-1-only to be equipped with lifting cleats
¼"x¾" Maple reinforcing cleat on inside
End
2-Required
Notes
Make top, sides and ends of redwood. Lifting cleats to be made of maple. Glue top, sides and ends together, then glue and drive ⅛" maple dowels.
All exposed corners and edges to be rounded by sanding.
Shellac 2 coats inside and outside.
Use 8 Ft. of ⅜ in manila rope.

Wood trough and box line protector for voltages 6,900-22,000

All troughs, dowels, straps and wedges are cut from one solid piece of redwood and thoroughly kiln dried. Material was then given two coats of insulating varnish, dried, assembled, given one more coat of varnish and again dried.


End View
Side View
¼" Maple dowels
Section B-B
¼" Flathead Bolt
Maple lifting cleats
Section C-C
Lifting cleat
Section A-A
Maple
1½" Round maple pole 8' long
Side Elevation
Lifting pole in place
¾"X¾" Bevel
Dovetail
Bottom
Notes
Insulating trough to be sawed from 1 piece of 4"X6"X5" straight grained redwood.
Shellac 2 coats inside and outside after assembly.
Lifting cleats and end pieces to be made of maple and held in place with ⅛" maple dowels, tight fit and glued.
All exposed corners and edges to be rounded by sanding.

Proper Motoring First Step in Power Factor Correction

Motors of sizes proper for the loads they carry will require the minimum amount of wattless current correction, which can be placed economically at motor terminals where it is most effective

J. L. MERRILL, ***Consulting Engineer, New York City***

POWER-FACTOR CORRECTION in an industrial plant, if it is to be done efficiently and economically, involves more than the mere reduction of wattless current by the installation of neutralizing capacitance. For minimum cost of correction and for maximum operating economy the first step is to eliminate unnecessary wattless current from the plant distribution system by proper motoring of drives.

Refer to Fig. 1, which shows the replacement of a 15-hp. motor on a cold steel saw by a 5-hp. This graph demonstrates that the reduction of wattless current by proper motoring reduces the energy required for a given amount of work, to say nothing of the decreases in conductor losses and in voltage drops resulting from improved power factor and reduced load.

These kilowatt-hour savings are much greater than can be made by any possible neutralization of the wattless current by outside means. As a matter of fact, in a great many cases the additional losses in group correction increase the kilowatt-hour consumption so much that their cost is more than the saving made by power-factor correction even with a large correction element in the rate. This is a point almost universally ignored in figuring the savings made by group capacitor installations as these savings are figured from the energy consumption after the correction has been made, and no attempt is made to estimate what the kilowatt-hour consumption would have been if the problem had been approached from the angle of first reducing the wattless current to a minimum by proper motoring. The unfortunate feature of this situation is that about the only way to get an accurate estimate of it is through an analysis of the kilowatt-hours necessary to do a unit of work in each individual plant, and such an analysis is seldom made.

A Relic of the Past

The idea that in general it is a good plan to over-motor is a legacy from direct-current days when there was no power-factor problem and when commutators limited peak loads on motors.

In the change-over from d.c. to a.c. current in a steel car plant which had a large number of heavy plate shears on which 10-hp. d.c. motors were found to be too small and 15-hp. motors had been substituted, the plant engineer objected when it was proposed to substitute 5-hp., 12 per cent slip, induction motors. He was very much surprised to find that these smaller motors carried the shears easily and gave even better operating results with less energy input than the original larger d.c. motors.

A shipyard plant was having seri-

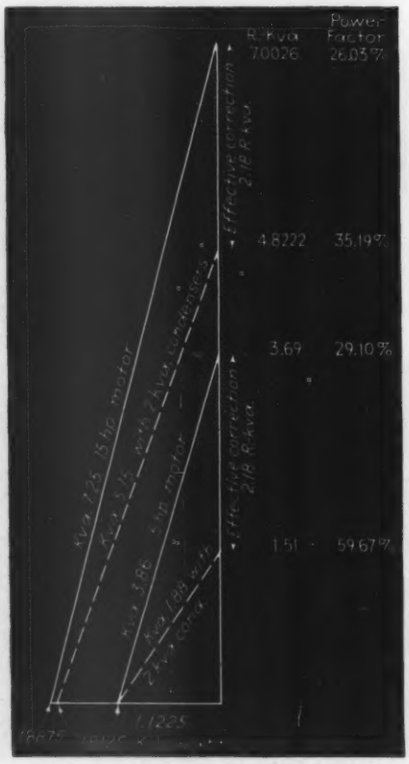


Fig. 1—5-hp. motor in place of a 15 on a cold saw

The readings for this graph were taken while the machine was sawing an 8-in. round bar of No. 1,440 steel for pinion blanks, which was claimed to be the most difficult cut that could be made by the machine.

The results of the test make it difficult to understand why such a large motor was put on this machine by the manufacturer. The maximum energy input on this cut was only 1.8875 kw. Perhaps the large motor was thought necessary for starting. But it should be noted that the 15-hp. motor was started by a compensator, so that only 9 hp. starting torque could be obtained under normal conditions. A 5-hp. motor across the line would give a starting torque of about 15 hp. (see Fig. 3). A 5-hp. motor on this load would reduce the kva. drawn from the line from 7.25 to 3.86, or 46.8 per cent, and the kw. from 1.8875 to 1.1225, or 40.5 per cent.

A point that appears in this graph is that the placing of 2-kva. of capacitance across the 15-hp. motor terminals, while it raised the power factor only from 26.03 per cent to 35.19 per cent, reduced the kw. input to the motor by 6 per cent. This test was repeated on several cuts of the same 8-in. bar of steel to establish that this difference was not due to soft spots in the steel bar. To this direct saving of energy at the motor terminals must be added the saving in line losses in the plant distribution system. The graph shows also the power-factor improvement resulting from a 2-kva. correction on the 5-hp. motor.

ous trouble on account of low power factor on the supply transmission line. The plant had a large number of the same size and make of the plate shears as in the car plant mentioned above and which had 15-hp. induction motors furnished by the manufacturer. The shipyard happened to have 7½-hp. motors available. These were substituted and the transmission troubles were not only relieved, but stalling difficulties that were affecting the 15-hp. motors due to excessive voltage drops at the motor terminals were eliminated.

In the change-over of the d.c. district to a.c. by a large Eastern utility one of the first plants to be changed was a shirt factory. Since the utility had a power-factor clause in the rate the power factor of this plant had to be raised. A change of motor for motor of the same size was made and the power factor was raised with a group capacitor. After the first month's operation the consumer complained that production was reduced 20 per cent and power bills had increased excessively. The plant was remotored with the proper size of a.c. motors with capacitors across their terminals. The production was stepped up to the d.c. point and the power bills brought down. Because of the reduced wattless current of the new motors the total cost of the individual group correction, although the price per kva. was double, was no greater than that of the original group correction.

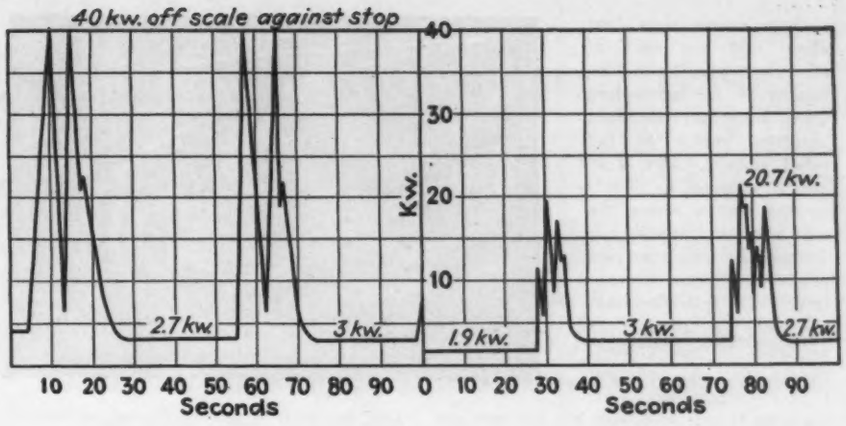


Fig. 2—Smaller motor, better performance

These records show the performances of a 25-hp., 5 per cent slip motor and one of 20 hp., 12 per cent slip on a forming brake making right-angle bends in sheet steel. With the 25-hp. motor the brake could not be used up to its capacity because the motor would stall. The left-hand record shows the 25-hp. motor performance with the brake making a right-angle bend in a piece of sheet steel 0.078125 in. thick and 12 ft. long. Note that the maximum input is plus 40 kw. It was proposed to install a 50-hp. motor on the brake in order to realize its full capacity. Instead, a 20-hp. with 12 per cent slip was put on. The right-hand record shows its performance making a right-angle bend on 0.1875-in. steel 11 ft. 9 in. long. The brake frame started to spring in this operation, but the motor and flywheel handled the load easily with less than half the energy input. It is apparent that a 10-hp. high-slip motor could readily operate the brake up to its full capacity, if the full torque range of the motor, as shown in Fig. 3, were utilized.

Examination of Drives

One of the chief advantages of raising the power factor of a plant by correction at individual motors lies in the fact that it requires an examination of all plant drives. Properly done, this provides opportunity for the elimination of bad motoring or bad motors. The saving thus accomplished by correct motoring alone is often much more than can be realized by any possible correction of the power factor.

Typical of what an investigation of motors and drives may disclose is the record of power input to a forming brake, which appears in Figure 2. This machine, equipped by its maker with a 25-hp., 5 per cent slip motor, was unable to work up to its capacity. Installation of a 50-hp. motor was considered, but engineering advice suggested a 20-hp., 12 per cent slip motor instead. The record shows its ability to handle load above the capacity of the brake and with power input reduced to less than half. Evidence of the suitability of the high slip motor to flywheel drives is clear from Fig. 3.

When in one of the large automobile factories it was discovered that presses driven by 100-hp., 5 per cent slip motors could be operated perfectly with 25-hp., 12 per cent slip motors and increased production obtained several carloads of motors were immediately ordered for wholesale replacements of these and other drives. A substantial saving in power bills, an improvement in plant power factor and an increase in the production of the machines remotored were realized.

No industrial plant investment is justified unless it can show a profit. A very elaborate test was made on a plant having a 120-kva. group capacitor installation, of which 103 kva. was in regular use. Conditions in this plant appeared favorable to this type of installation and the saving by the power factor rate clause apparently justified it. It was possible to adjust the load so that it was the same over eight-hour periods on three successive days. The first day the plant was normally operated with the 103-kva. bank of capacitors. On the second day the same load was carried without correction. On the third day the same load was carried with 65 kva. in individual capacitors distributed on the motor terminals.

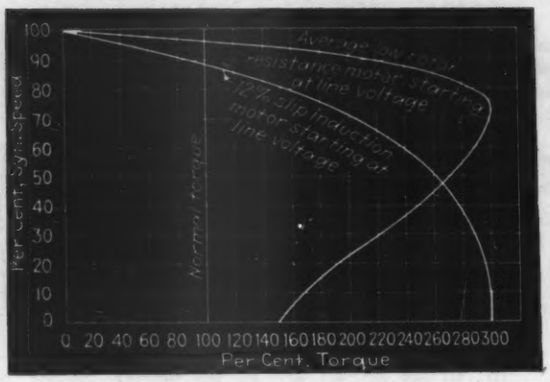
The group capacitor installation was situated at the distribution switchboard adjacent to the stepdown transformer vault about 400 ft. from the group of motors concerned. They were directly connected to generators for charging storage batteries, and it was this condition that made it possible to regulate the load during the eight-hour periods. The copper between the plant and the motor switchboards was about four times as heavy as would have been used in an ordinary installation.

The same power factor was obtained at the plant switchboard with the 103-kva. group capacitor installation operating as with 65-kva. individual capacitors on the motor terminals. But figured on a monthly basis the individual installation showed a drop in actual consumption from 17,000 to 13,500 kw.-hr., or 20.6 per cent. This result was so surprising that the test was continued for two weeks to check it, and did so.

No Danger of Over-Correction

One of the early objections to individual correction at the motor terminal was the idea that if enough correction was put on a motor for no

These curves show that about 300 per cent of normal torque can be figured on for momentary loads from any standard induction motor at full rated voltage. This is in radical contrast to direct-current motors where the overload capacity is limited by the carrying capacity of the commutators. On induction motors all line connections are solid. If these connections are of sufficient capacity momentary overloads up to not more than 300 per cent are perfectly safe provided the average integrated load during operation is not over the full rated load of the motor.


Per Cent, Syn. Speed
Normal torque
Average low-speed resistance motor starting at line voltage
12% slip induction motor starting at line voltage
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Per Cent, Torque

From the curves it will be noted that a short-circuited rotor induction motor having 150 per cent starting torque can exert 300 per cent when it reaches about 72 per cent of its synchronous speed. This motor, if a peak load is applied that pulls the speed below 72 per cent, will stall and tend to stop unless it is carried over by the flywheel of the machine which it is driving. The effect of this is an instantaneous stalled current on the line with the resultant low power factor, low voltage and a braking action on the flywheel.

Installing a larger motor of the same characteristics will often merely aggravate these conditions. For a flywheel to deliver its stored energy it must drop in speed, and this drop is usually figured at around 20 per cent. Thus, the braking effect of a motor that stalls before the speed drops that much reduces the effective work that the flywheel can deliver. The fact that 5 per slip motors are still quite commonly installed on flywheel-equipped machines by the makers of such machines is a rather bad reflection on motor manufacturers.

The curve of the motor with a 12 per cent slip shows that a motor with these characteristics will give its full 300 per cent torque at start or zero speed, and at this point will put no more load on the line than when starting. This point is extremely important in making motor applications and demonstrates that on many applications short-circuited rotor induction motors can be used where slip ring motors have been thought necessary. Figs. 1 and 2 illustrate this point further.

Fig. 3—Flywheel drive requires high-slip motor

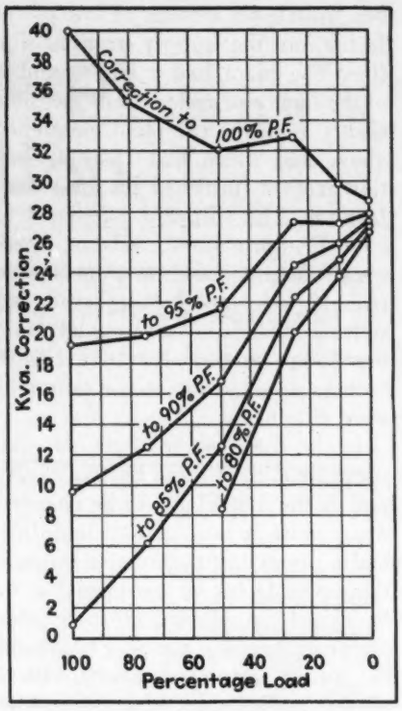


Fig. 4—Various corrections at various loads

These curves are of average values obtained by testing every fourth one of a lot of 105 motors, all 75 hp., 3-phase, 60-cycle, 440-volt, squirrel-cage. The curves indicate that practically a straight line of around 97.5 per cent power factor from no load to full load can be obtained on these motors by a condenser capacity of about 28 kva.

load, this amount would produce a leading power factor at full load. But this is an error, as is shown in Figure 4. In general, it has been found in practice that if sufficient correction is put at the motor terminals to prevent a power factor, at any or no load, of less than 60 per cent, a satisfactory operating efficiency is obtained on reversing motors or those having a violently fluctuating load cycle. This amount of correction will usually prevent too low voltage at the motor.

If in laying out a plant the reactive current is considered in the same manner as the active kw. in figuring the lines and motor applications the whole problem is very much simplified. To take one illustration, a small seamless tube drawing plant with a connected load of 450 hp. in motors, ranging in size from fractional to 25 hp., wished to correct the plant power factor from 49 to 95 per cent. Most of the motors were on violently fluctuating loads and many of them on reversing service, with as high as 10 to 20 reversals per minute.

In checking over the motors in this plant one bad one was found, a 15-hp., 900-r.p.m., two-phase, 60-cycle, 220-volt motor that had a reactive input of 30 kva. instead of the 7.5 r.-kva. that it should have had on its load. Since a 5-hp. motor was found sufficient to carry the load, this motor was taken out and was supposed to have been scrapped. The plant power factor was being corrected with capacitors on the terminals of the individual motors at $60 per kva. Service to the plant was supplied through kilowatt-hour and r.-kva.-hour meters, from whose readings average power factor was calculated and used in billing.

The capacitor installation was made gradually, each installation being carefully checked, and the plant power factor rose until it reached 92 per cent. The next month it dropped to 82 per cent. An investigation revealed that a small air compressor had been installed and the bad 15-hp. motor which was supposed to have been scrapped put on it temporarily.

When this was called to the attention of the plant manager he said that a 15-hp. motor in an installation of 450 hp. couldn't make so much difference. It was a simple matter to show him that it did by having him watch the disk of the r.-kva.-hour meter, which barely moved when the motor was off the line and spun around rapidly when it was put on. Then it was explained to him that in order to get a power factor of 95 per cent at his average load the total reactive of his plant couldn't be more than 25 r.-kva., and this motor alone added 30 r.-kva. The whole matter was brought home to him by taking his last two power bills and showing him that his experiment with this bad 15-hp. motor had added $200 to his power bill in the part of a month it had been connected. This was nearly double the price of the 5-hp. motor with its correction that should have been used to drive the compressor. The change to the 5-hp. motor was made immediately and the plant power factor went to 97 per cent.

An interesting feature of this installation was that an estimate was made of the kilowatt-hours saved per ton output of the plant, which, added

[*Continued on page 30*]

Device Allocates Load on Incremental Heat Rate

Logarithmic representation of incremental heat rate for each station set-up reduced to linear scale for load allocation among stations on operating slide rule—Fuel cost covered

H. JOHNSON and M. S. UMBENHAUER, *Consolidated Edison Company of New York, Inc.**

ALLOCATION of load among generating units at the time the load is about to be encountered is made possible by a graphic device which is founded on the incremental heat rate for each unit, each group of units or each station. It provides in simple manner the means for converting heat rate into fuel cost rate, wherever stations are operating with fuels of different cost B.t.u. The system operator merely places on the allocation board the graduated scales which have been prepared in advance for typical unit aggregations and ascertains where to assign additional units at lowest over-all incremental cost.

Particularly does the scheme avoid the difficulties encountered by prior comparable plans through the fact that on a large interconnected system the number of possible combinations of running units may run into many thousands. A chart for each entails a great expense for engineering analysis and draughting as well as precluding operating allocations close in tune to the expected loading. There has, therefore, been a call for some means by which the load dispatcher could instantly determine the economical allocation of loads under the system conditions prevailing at the time of demand. There seems also to be call for a device which would make possible accurate billing for energy interchanged under a pool arrangement. The device to be described accomplishes both functions.

The first natural step to accomplish the desired objective was to resort to logarithmic plotting of incremental heat rates. This makes it possible to multiply the incremental heat rate by the relative fuel-unit heat cost, merely by raising or lowering the curve by an amount (see Fig. 1) proportional to the relative fuel unit heat cost. Instead, however, of preparing these data as curves with load as abscissas on transparent material for superposition, the station-combination data are set up as a linear scale with load labeled against a logarithmic scale graduated in heat rate increment. The method of preparing each strip is detailed in Fig. 2.

Fig. 1—Board indicates economic division of loads for benefit of system dispatcher

Many thousands of schedules would be necessary to cover all likely system conditions, but a few hundred of the above loading strips are found to suffice for even the larger systems.

After establishing the strips it was only necessary to build a frame with slots to hold the strips in their proper relative positions and to guide the slider. This was done and a picture of such a device is shown in Fig. 1. The size of the frame will, of course, be dependent upon the size of the scale chosen to represent the incremental heat rates logarithmetically.

Establishing this scale then becomes the first consideration in building one of these devices. In developing a suitable scale four factors must be considered: (1) Range of incremental heat rates to be covered, (2) the maximum length available for the scale, (3) the width of the divisions on the scale, (4) and finally, the length of scale of the dependent relative fuel cost adjustment scale. A scale was laid out for the device shown, in which load was economically divided between three turbo-generator stations. Their incremental heat rates ranged in extremes from about 9,000 to 28,000 B.t.u. per hour per kilowatt. Therefore, it was decided that a scale range from 8,000 to 30,000 B.t.u. per hour per kilowatt would allow for any reasonably anticipated expansion. To keep the strips from being awkward to handle, their length was limited to 36

Mr. Johnson is assistant engineer and Mr. Umbenhauer engineering assistant in the system efficiency bureau.

Article abstracted from paper awarded second prize in the James H. McGraw engineering competition of the E.E.I.

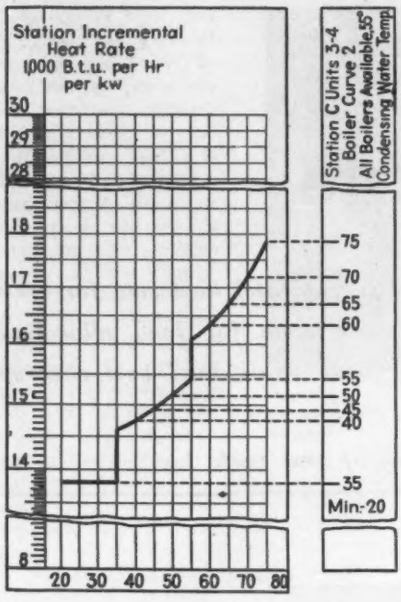


Fig. 2—Familiar loading curves converted to linear scales

The points on the curve corresponding to any desired load values are transferred to the strip by projection. The load values for each point are printed adjacent to the mark corresponding to the point. It may be noted that when the incremental-heat-rate is constant for a range of load that it is only necessary to mark the highest load obtainable at that rate.

It is obvious that the curves were thus compressed into a size and shape suitable for easy handling and convenient filing. Since the strips are narrow, they can be conveniently placed beside one another for comparison. There is therefore no need for having the strips transparent.

inches. This allows sufficient room for marking loads and also for identification titles at the tops of the strips.

In the frame the incremental heat rate scale was placed in the left slot (Fig. 1). Each loading strip placed in another slot then starts at the bottom with 8,000 B.t.u. per hour per kilowatt. Loading strips representing stations having the same fuel unit heat cost will all be dropped in the slots until their bottoms rest on the base line (slot B). But if C and D stations have higher fuel unit heat costs their bottom ends will be raised (by a stop) above the base line by a distance proportional to the respective ratios of fuel unit heat costs. The corresponding scale provided at the bottom of each slot is drawn to the same unit length per logarithmic unit as scale A.

For interconnected systems involving energy transfer an incremental-cost-scale reading in cents per kilowatt per hour of incremental cost can be constructed on any fuel cost basis. In the case shown the basis is a fuel cost of 15 cents per million B.t.u. This is equivalent to 0.000015 cent per B.t.u.

Since scale "G" is a logarithmic function, the divisions on scale "H" representing fuel costs from 15 to 20 cents per million B.t.u. must be made the same as the divisions on scale "G" representing from 0.150 to 0.200 cent per hour per kilowatt. With the hair-line set to any incremental heat rate on scale "A" the incremental fuel cost may be read directly on scale "G" opposite any fuel cost shown on scale "H."

Further adjustment to scale "G" is provided by the "Per Cent Adjustment Scale," shown at "J" Fig. 1. This is imprinted directly on scale "G." Often on interconnected systems the pool agreement provides that a percentage of the incremental fuel cost be added to the incremental fuel cost to allow for additional maintenance, labor, etc. Since this scale is a percentage adjustment or ratio scale, it was constructed in exactly the same manner as the relative fuel cost adjustment scales, as previously described. By setting the desired percentage on scale "J" at the base line, scale "G" will indicate the incremental fuel cost plus the added percentage opposite any fuel cost on scale "H."

Basis Is Low Cost Station

This device complete with scales and "loading strips" for all combinations of units at each station for the various seasons and operating "set-ups" should be placed convenient for use by the load dispatcher. By means of an index system very little time is needed to find the correct "loading strips" required. The "loading strips" for the conditions prevailing at each station are inserted in the slots with their bottoms set on the relative fuel cost adjustment applicable to the station. In practice, the station having the lowest fuel unit heat cost should be used as the base for the fuel cost adjustment ratio. For economic division of load between stations the dispatcher always reads the loads below the hair-line on the slider from the station "loading strip." If one station cannot meet this economic demand because of some limitation, it should be given as near economic load as possible, and the remainder of the stations loaded as indicated under the hair-line by raising or lowering the slider until the total demand is met. This effectively gives next best economic loading.

To determine the economic interchange of power on systems where pool contracts are involved the dispatcher has before him at all times the actual incremental costs. By a simple comparison of the incremental costs of the interconnected systems he can easily determine the direction and amount of power flow.

In a system generating more than one form of energy for sale (such as steam and electricity), and having the sources of supply so interconnected that the incremental cost of one is dependent upon the others, then a separate incremental cost scale is required for each form of energy. By comparison of the costs as indicated by these scales the economic generation of all energy is determined.

Proper Motoring First Step in Power Factor Correction

[*Continued from page 28*]

to the direct power factor saving, paid the correction cost of $7,200 in less than a year.

Obviously it doesn't pay to attempt to correct wattless current that can be eliminated by proper motoring, especially since the cost of proper motoring from every standpoint is less than of the correction required by poor motoring. The savings in service bills and the benefits of increased operating efficiency are much more than any possible bill reductions deriving from power-factor clauses. As a matter of fact, the application of correction at the motor terminals is justified on reversing motors having violently fluctuating loads from the standpoint of operating efficiency alone, even where there is no power-factor clause.

From the foregoing it can be seen that the power-factor problem in any plant resolves itself in two distinct phases; the first and most important is a question of motoring and motor application and the other a question of the actual correction of the wattless current. In other words, the mere neutralization of the wattless current of a plant by group capacitor correction or by synchronous motors is the smallest part of the problem if it is to be taken care of in the most profitable way for the consumer. Such a group installation may even increase the cost of the service for the work done despite the saving that it shows in the rate by increased power factor at the incoming service.

Perfecting plans for a united drive on the electric roaster market, a dozen jobbers and distributors met with Texas Power & Light at this organization meeting. Vice-President Richardson of T. P. & L. and Douglas Havens of Westinghouse standing in center

Builds Roaster Volume Through Utility-Dealer Organization

Texas Power & Light promotion results in load-building with roasters by 142 new retail outlets in 28 districts — Company sees large field open

G. B. RICHARDSON, ***Vice-President, Texas Power & Light Company, Dallas, Tex.***

DEALER co-ordination, a tie-in between our company's field representatives and local dealers of the widespread territory served by the Texas Power & Light Company, has proved to be the most effective manner by which to promote the sale of a specialized item, such as electric roasters. Our success in recent months with an activity of this nature definitely establishes the fact that a large field is still open for residential load building.

From the latter part of April through September, a specialized campaign aimed at producing sales results in the electric roaster field produced 142 new electric roaster dealers in this territory.

Our dealer roaster activity began with a general meeting in Dallas attended by jobbers and distributors, together with their territorial salesmen. We announced our plans, gave them a preview of the type of demonstration to be held in each of our company's 28 districts and promptly secured enthusiastic approval.

The next step was to inform the local dealers of details of the plan and secure their co-operation also. This was made possible through the presentation of a 54-page easel chart talk—a 25-minute program—pointing out roaster sales opportunities, the long-range program for creating customer acceptance of electric roasters, the national promotional and advertising campaigns scheduled by the Modern Kitchen Bureau and manufacturers and the local promotional and advertising program of the Texas Power & Light Company.

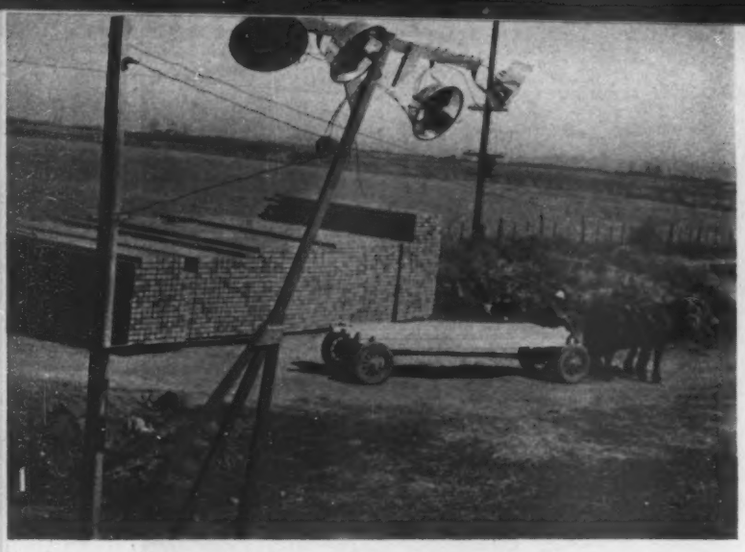
The initial series of electric roaster meetings produced a total attendance of more than 300 dealers and resulted in the establishment of 53 new retailers to serve our customers.

Taking the initial effort as a guide, we decided to enlarge the opportunities for increased roaster sales by conducting a second program holding a two-fold purpose—to interest additional dealers in retailing the electric roaster, and actually to train dealer sales personnel in the most effective sales methods in accomplishing this purpose.

A "Ten-Step Roaster Selling Plan" was the answer, presented in playlet form, with a cast of the dealer sales girl, the typical roaster prospect and two commentators who pointed out the use of sales psychology, etc. The plan quickly proved to be a distinct aid for the merchandising effort. At this same meeting, which, of course, was held entirely for the benefit of local dealers, actual cooking demonstrations were held utilizing all makes of roasters. The food thus prepared was served to those in attendance.

An even more gratifying response came as a result of this second series of meetings, 858 people attending, representing dealers, their wives and salesmen. It will suffice to say that 89 additional dealers began handling electric roasters as a direct result of this activity.

Too, our dealer co-ordinators, constantly in the field calling on jobbers, distributors, dealers and salesmen, furnish information, sales tips, services and friendly co-operation, which inevitably lead to better relations and easier load building.



UTAH POWER & A BIG

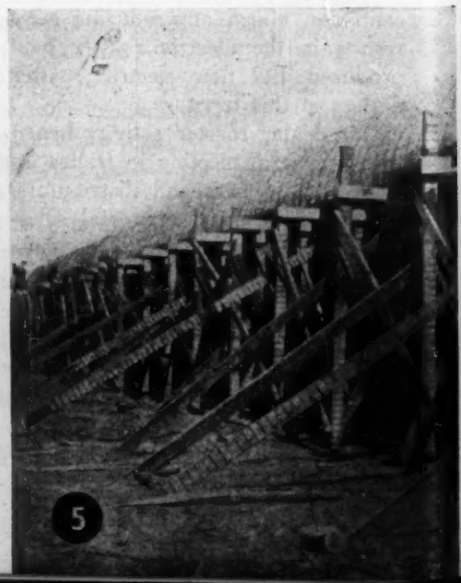
1 Labor and lumber were major items in reconstruction of the 5,000-ft. section of 11-ft. diameter wood-stave flowline to Grace (Idaho) hydro plant—a job undertaken this year by Utah Power & Light Company and completed in 31 days. Thirty-five carloads of 4x6-in. stave lumber, costing $47,000, were stored in piles like this one, for seasoning by free circulation of air.

2 First step, as far as construction proper was concerned, was wrecking the old line, excavating and grading, placing saddles for the new. These fabricated-steel saddles replaced concrete, the better to withstand freezing. Eight carloads of saddles were involved—625 saddles in all, each saddle weighing 750 lb.

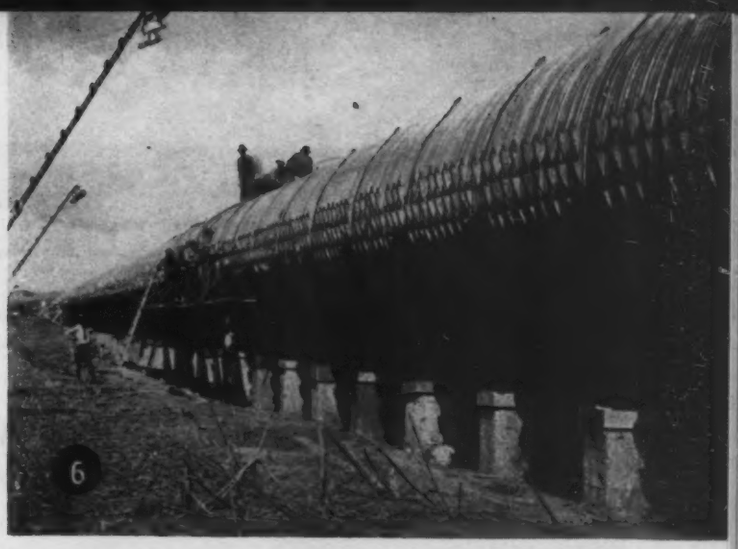
3 Preparatory to this stage of the work were installation of a plant to furnish light and power and the milling and distribution of staves. Surfacing and milling were done in the field, 50,000 board-ft. being handled in 24 hours. Here the construction is being carried over a vertical curve.

4 Speed was essential because the line carries water for the three 11,000-kw. units at Grace plant, which is an important source of energy for the system. Hence field work was kept moving with three daily shifts. Crews were organized with one foreman to each twenty men. On the job were 500 men, and labor costs were $55,000.

5 Twenty-one days after the pipe was taken out of service lumber on the new section was in place. Five days later the

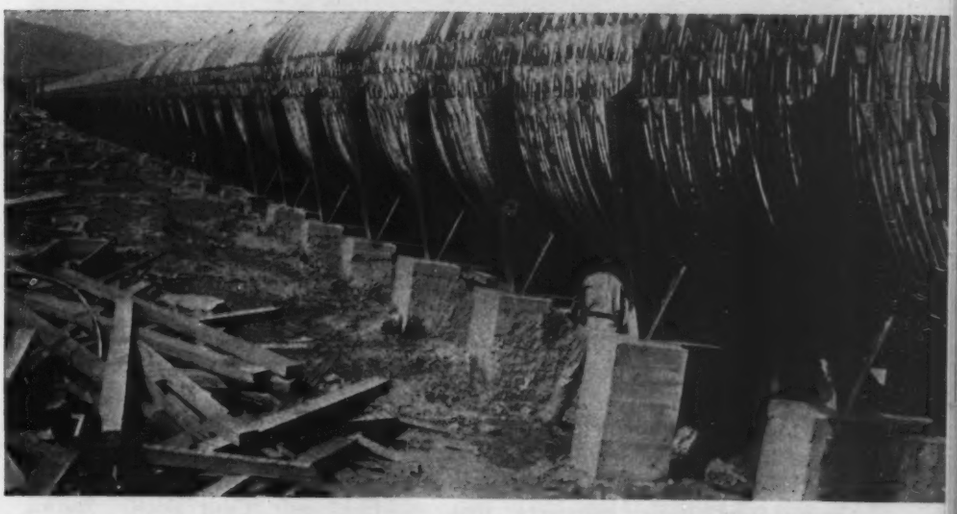


LIGHT BUILDS WOOD PIPE



structure proper was completed. The staging for construction work, shown in this picture, was built of staves taken from the old line. To fasten the staves in place 25,000 butt-joint assemblies were required for the whole job.

6 Banding the pipe was the last stage of construction proper. Bands were reclaimed from the old line, a job which necessitated salvaging and reconditioning 40,000 pipe-band shoes. Air-impact wrenches speeded the job and a tap was run through nuts before they were reused. Lights for night work were rigged to provide a clear working area. Dishpans (see close-up, Fig. 1) were used for reflectors.



7 Original concrete footings were repaired and grouted under bearing surfaces of the new steel saddles (forms are in place in Fig. 6). When the structure was completed water was admitted, and there followed a five-day job of adjusting band tensions, especially to prevent crushing the staves as lumber swelled when water was admitted to the pipe.

8 Accuracy was the keynote in measurements of pipe and saddle deflections. Careful planning and co-operation of the various departments of the company involved constituted the keynote of the job as a whole. Even a field first-aid station was established, with an attendant always on duty. In direct supervision was J. L. Jameson; assistant superintendents in the field were Arthur Adams, Leo Adams and Dan Beck; H. B. Terry was engineer.

Capitalizing on Complaints to Improve Service

Chicago utility puts customer criticisms under microscope — Uses accounting methods in classification and analysis — Confers on results to improve service

L. A. FERGUSON, Jr., *Service Manager, Commonwealth Edison Company, Chicago, Ill.*

THE very word "complaint" has always been anathema to the utility business, and it is only recently that most companies would even tolerate the word in print. However, in the light of past experience and present conditions, perhaps now is the time to admit that complaints form a normal part of normal utility progress and to make a unified effort to capitalize them with so much intelligence that we can guide our future progress away from those influences that are everywhere jeopardizing private progress today.

In Chicago we are attempting to do this by merely applying some good accounting practice to the only phase of our business that thus far has escaped the statistician. The general system for the classification of complaints, as it is used by four companies in northern Illinois, offers a means of keeping a running record of all kinds of thinking on the part of customers which we can use as a weathervane for trimming our sails to meet the whims of our changing times.

In the old days we used to keep a detailed record of complaints in an old-fashioned "Cash Book," known throughout the company as "The Growler." However, the transition from this first recording of customer opinion to the present system has not been made overnight. Our first attempt to measure public opinion accurately was made in 1925, when we hired a special research organization to make a survey. This proved to be expensive and we were prone to question the results whenever they ran contrary to our own opinion or to point too much with pride when they were complimentary. We tried it again, ten years later, through the medium of a national advertising firm and its conclusions were too much like those of the original survey.

On our next attempt we decided to do the job ourselves and it wasn't long before a committee from our allied companies hit upon the idea of using our own routine complaints to obtain comparable figures month by

FIG. 1 — THE TOTAL OF ALL COMPLAINTS RECEIVED DURING AN AVERAGE MONTH IN 1938

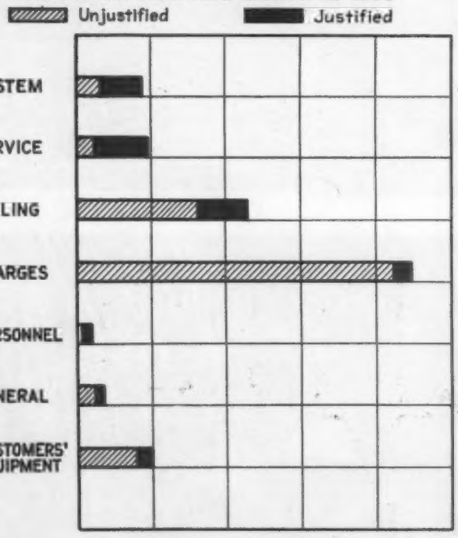


Fig. 1—Only a small portion of all complaints are "justified"

FIG. 2 — DETAILED CAUSES OF JUSTIFIED COMPLAINTS

NOTE — Parenthetical figures indicate the number of additional subclassifications available for allocating the causes in greater detail than is shown here....

A SYSTEM	%
Stations (2)	1
Overhead (27)	19
Underground (4)	1
Services (9)	30
Meters (5)	45
Other causes (4)	4
Total	100

B SERVICE	%
Applications (9)	24
Installations (7)	4
Lamps (3)	1
Repairs (3)	5
Deliveries (7)	6
Load checks (3)	60
Other causes	0
Total	100

C BILLING	%
Reading (5)	10
Bookkeeping (16)	33
Bills (12)	45
Collecting (4)	6
Other causes	6
Total	100

D CHARGES	%
Wrong rate (4)	98
Repairs (3)	1
Deposits (3)	0
Appliances	0
Lamps	0
Other causes	1
Total	100

E PERSONNEL	%
Courtesy	1
Conduct	4
Performance	47
Misinformation	48
Other causes	0
Total	100

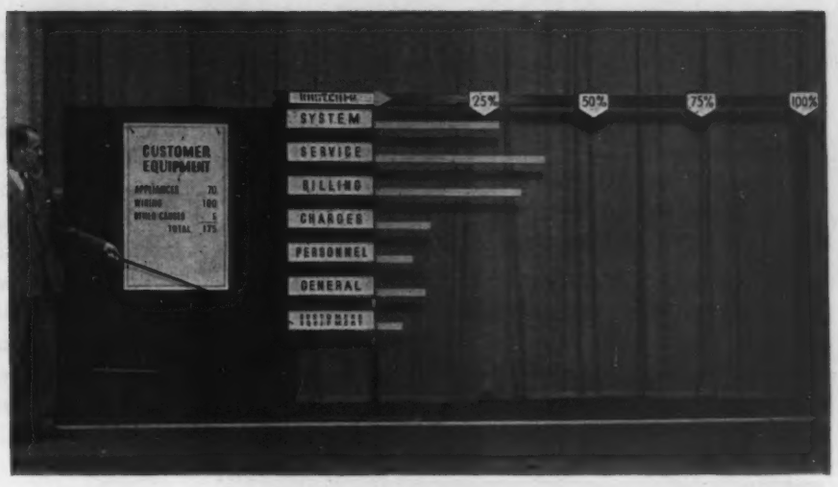
F GENERAL	%
Injuries	18
Damages	36
Static	1
Restoration	27
Other causes	18
Total	100

G CUSTOMERS' EQUIPMENT	%
Appliances	40
Wiring	57
Other causes	3
Total	100

Fig. 2—Breakdown justified complaints into detailed causes for typical month

month instead of decade by decade. Need for knowing how to analyze these complaints led to the uniform classification of customer complaints as it now exists.

Every complaint, whether received by letter, telephone or personal contact, is first investigated, and if the company is found to be at fault the complaint is classified under one of the following headings descriptive of the underlying cause: (1) Systems and equipment, (2) service transactions, (3) billing and accounting, (4) charges, (5) personnel, (6) general, and (7) customer's equipment. Complaints for which the company accepts full responsibility are the easiest to capitalize because they tell us exactly where the trouble lies and why the fault is ours. We don't have to wait for those slow accumulations of complaints which develop intolerable situations that are so expensive to eradicate.



Author shows the portion of monthly justified complaints in each cause classification

Many "Unjustified" Complaints

As seen from the accompanying chart (Fig. 1) "unjustified" complaints make up a good proportion of the total under each classification. Part of these complaints may have a basis in repetition which arises from unsatisfactory explanations. To reduce erroneous thinking, and guide our treatment of it, we are now developing a new form of classification which will disclose reasons which cause customers to complain just as we are now able to disclose our own errors, as they develop from customers' complaints.

To return to the justified complaints, however, each of the seven major classifications is broken down into a number of subclassifications, as indicated on Fig. 2, to show at a glance where and why the company is responsible.

System—Complaints caused by defects in our system or equipment are broken down into 51 subdivisions, as indicated in "A" of Fig. 2. Complaints against our *four stations* and *100 substations* are exceptionally few. Failures in *overhead systems* are broken into 27 subdivisions for detailed analysis. Because of its nature, our *underground system* is not expected to cause much trouble and five subdivisions are sufficient. *Service* with nine subdivisions is carefully watched for increase in complaints due to defective brackets or service taps. *Meters* has five subdivisions to aid in averting complaints before they become serious.

Service Transactions, broken down into 33 divisions under this heading, indicated in "B" of Fig. 2, is watched closely for complaint increases due to errors in applications and in checking loads for rate purposes. To capitalize upon this information, we recently modernized all apparatus and procedure for order taking. Recent simplification of our rate structure has reduced the next great source of complaints.

Billing, with 38 subdivisions, shows the bulk of complaints under bills where "average bills" and "discounts" among the twelve subdivisions are the main offenders.

Charges—It appears that we have too many subdivisions (thirteen) for complaints. They might all be consolidated into one or two, but we prefer to leave them there as potential causes for complaint, and this illustrates the need for frequent review of any such classification—for it is often too easy to maintain a lot of red tape, too long after it has ceased to be useful.

Personnel, covering courtesy, conduct, performance, misinformation and other causes, is always interesting and perhaps the most important. The item "performance" relates principally to handling of complaints. "Misinformation" is occasionally large because an over-ambitious field salesman may become over-enthusiastic in his work.

General—Provides a place under "restoration" for those "Acts of God," such as heavy dews that wash away bridges in California, or ocean breezes from Florida, that extend further up the coast. We use this to record excessive complaints that result from extraordinary operating conditions. This helps to keep yearly complaint comparisons more in line with normal system operations.

Customers' Equipment—Applies to complaints caused by non-company apparatus. Such complaints are treated separately because we have so little control over them. Plans are now under way to change the title of this classification to "appliance sales," so complaints against appliances under guarantee may be segregated from those against old appliances or those purchased elsewhere.

Committee System

Existence of these data in monthly master control sheets is far from enough because to be effective as a tool of good-will these data, assembled monthly, must be analyzed and administered to improve operation. In Chicago we use the committee system for centralizing control over the classification of complaints—under direction of a vice-president in charge of service. This committee, composed of members from the ten or more different departments having direct contact with customers, meets monthly to study the complaint record and all other subjects pertaining to customers' service. In this meeting the month-by-month trend in complaints is studied and preliminary plans laid for reducing excessive complaints under any single classification.

In addition, there is also an inter-

[*Continued on page 83*]

Editorials

S. B. WILLIAMS, *Editor*

Low Money Rates and Return

WHAT is going to be the effect of present low interest rates on the allowable rate of return on utility investment? If coming events cast their shadows before them, then the recent decision of the Supreme Court of Illinois in the Peoples Gas Light case can be taken as an indication of possible new bench marks for return.

The court held that in view of the present cost of money a return of slightly in excess of 5 per cent was not confiscatory. Today's low yield on bonds was cited, as was also low interest rates on bank loans.

The holding of 5 per cent as not confiscatory does not necessarily mean that this figure constitutes a fair and reasonable return, but it does indicate that 6½ to 7 per cent, now the accepted return, is vulnerable. The longer low money yields continue the greater will be the pressure for lower rates of return and correspondingly lower energy rates.

This does not mean, however, that state commissions will begin to accept 5 per cent as a reasonable return. There is a real distinction between what is not confiscation and reasonableness.

It must be remembered that the return allowed by regulation is not a guarantee, but is simply the top beyond which earnings may not go. In effect, it means that in good times a utility may earn so much and no more. But what of bad times? The lower the permissible return the smaller the cushion above bond interest. It is this protective cushion which is relied on to ward off bankruptcy during depressions as well as to provide funds at low rates when new construction is needed.

Also, the financial stability of a utility property depends to a degree upon the equity participation. Stockholders are the ones who take the gamble. Since risk and opportunity for gain are inseparable, there must be something considerably more than mere interest yield if people are to purchase stock. Equity investors must be considered more than ever, for the industry is beginning to expand its investment account. To expand for long without additional equity financing is courting trouble when the next serious business slump comes.

Next year the utility industry expects to spend 600 millions or more in new plant. The industry probably has something in excess of 300 millions in reserves that can be used to finance this contruction. It will need, therefore, 300 millions of new money. There is no question about getting the money; the reasonableness of the regulatory commissions with respect to return may be a factor in determining what kind of money it will be.

Commissions generally have been mindful that they have an obligation not only to the consumer but to the investor as well, and for that reason have been hesitant to lower rate of return drastically. There is no reason to suspect that this policy will change.

On the other hand, basing return upon the cost of money may be a very helpful precedent should we have inflation. Such a precedent could have been used twenty years ago. It might come in handy again in a whole lot less time.

Wood Molding Passes On

GOOD-BY wood molding! For years it had virtually ceased to be employed as a wiring method, but still it stayed in the National Electrical Code. Sentiment, perhaps. Anyway, it is now out of the Code.

Wood molding has been displaced for surface wiring by metal and a much less conspicuous and probably less expensive job has resulted. Metal molding is better, also, from the standpoint of wire capacity, as a raceway, and because with today's mechanics it is doubtful if you could get a wood molding job of several circuits that wouldn't be an eyesore. Years ago, however, when wood molding was in fashion, workmen took pride in their work.

People today laugh at a wood molding job, but let us not forget that it served its purpose well at a time when electricity was not so well accepted. It was a safe and inexpensive way of introducing wiring into an unwired building. It came in before the art of fishing was established.

The utility industry owes a lot to wood molding, and while no one wants it continued sentiment causes us to take off our hat as it passes on.

Fuel Efficiency and the Drought

DURING the recent widespread dry spell and the consequent reduction of output from water power, when the demand on fuel-burning plants rose to unprecedented magnitudes, the reported use of equipment that had been taken out of active service and retained merely as standby led in some quarters to the belief that inefficiency and waste of fuel would result.

The facts as found in reports of the Federal Power

Commission do not appear to support this view. In the annual "Electric Power Statistics" for 1938 the average consumption of coal or its equivalent in oil or gas is given as 1.41 lb. per kw.-hr. The method of computing equivalents is given in the 1937 Census (page 11) of the Electric Light and Power Industry. Results from this method closely approach the FPC figures.

This average of 1.41 lb., however, includes railway and other plants, for which the consumption works out as 1.64 lb., while the average for the light and power industry alone comes to 1.39 lb. Confining the analysis to the latter group, consumption in January, 1939, was 1.36 lb. per kilowatt-hour. It was the same in May, dropped to 1.34 in July, also 1.34 in September, and then went down another notch to 1.33 in October, the lowest average ever attained for any month. By the same method of computation, a year ago it was 1.39 in September and 1.37 in October. Evidently the continuous increase in efficiency of use of fuel was not interrupted by the heavier loading of steam plants and the temporary use of older equipment.

Far from being wasteful, the procedure used was economical. The higher rate of fuel consumption by the older plants, with their relatively small outputs, had little effect on the average, reduced by the higher efficiencies of the great modern plants that supplied most of the output.

Incidentally, if there had been no improvement compared with a year ago the output in October would have required an increase of about 170,000 tons of coal, or its equivalent, above the amount actually used.

What Do We Know About Ground Characteristics?

THE EARTH is getting to be more and more an indispensable adjunct of power delivery, not the inhabited earth with its eager consumers, but the subsurface earth that carries the protective grounding. Portions of systems which formerly seemed to work best when isolated are now being grounded. Faults to ground are more common than the phase-to-phase kind, and it is natural that, in the advances in protective facilities, more reliance should be placed on facilitated ground fault currents to clear the trouble promptly. Certainly the trend toward common neutral distribution has accentuated the importance of effective grounding.

Actually, however, much more is known about what happens electrically in rampant atmosphere than what happens in the more tranquil ground. Professor H. B. Dwight has contributed much practical theory about the merits of multiple grounds and manufacturers of grounding facilities and instruments have added usefully to working knowledge. Nevertheless, the characteristics of earth as to capacitance and conductivity vary widely—far more widely than the geographical diversity in atmospheric characteristics. Consequently there persists a vagueness about the technique of grounding which is not wholly clarified by the excellent determinations obtainable from instruments devised to reveal quantitative facts about the probable efficacy of grounding.

With as much spent (if not more) for grounding as for aerial protection against lightning and glaze, it appears that there should be an intensification of effort to collate the characteristics of grounds. Are multiple grounds less effective and more expensive than single deep grounds? Are prevailing practices of grounding unit and bus section neutrals at stations a holdover from an era when system-wide protection was on a different plane from the present trend?

Maybe the widely varying characteristics of local grounding preclude much extension of theory, but it is logical to assume that the empirical procedure of collating the experience from all territories and all systems would bridge the gap and provide a surer base from which to improve system reliability as well as safety.

Definition of a Forced Outage

LITTLE BY LITTLE more emphasis has been placed on reliability of performance, and quite naturally measures of reliability are being devised to indicate the relative performances quantitatively. In many respects, however, the most important criterion is the matter of forced outages as contrasted with those failures which inevitably occur, but at times when the consequences are not as distressing.

Such a yardstick as "forced outages" can hardly have equal meaning, even for comparable equipment on different systems, unless there is provided a better agreement than what is now available as a definition of forced outage. Conversely, there is equally little agreement on what constitutes availability factor, because availability factor is in a sense the inverse or complementary ratio to outage.

It is a tough topic to define, because there are so many variables involved. One could even call an outage a forced outage if peak or load circumstances demanded the availability of the equipment, even though it had come to need scheduled attention during a period when its availability was not normally required. Nor is it an easy matter to define rigorously the system conditions which will or will not call for the availability of certain pieces of apparatus.

Nevertheless, the relative merits of particular designs and particular assemblies will be more clearly set up as a guide for reliable system design if there could be a clarification of the matter of availability and outage. Provision of reserves would be that much more a matter of precision. Capital and operating expenses could be conserved to a somewhat better degree. Makers of equipment as well as the users would have at hand an index of relative performance that would be distinctly useful. For that reason makers could well join with users in striving to arrive at agreement on what constitutes scheduled outage, forced outage and availability factor. All deserve the standing that plant factor and utilization factor have attained.

Congress to Be Tough on Power Spending

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

TOUGH is the only word for the Congress that will be back on Capitol Hill in a few days. Tough and selfish, every senator and every representative, with exceptions so few that they can be taken as proving the rule, with an eye alone to his own political future. Every word and every vote will be determined by the estimated effect such word or vote will have on renomination and re-election.

This situation is good for the electric industry and for business in general. It will be bad for the left wingers. The day of making votes by attacking the utilities has passed, along with other sham battles. Did you notice that the last time Big Bill Thompson, out in Chicago, tried to get somewhere by pounding the King of England he didn't?

National legislators who are already in Washington report that the folks back home are getting interested in national economy. This ought not to be news, but it is. One of the most difficult things in the world is to guess when and why, but particularly when, the voters will get interested in a particular issue. Being able to forecast it, is apt to carry a man far.

Debt Limit

So the consensus of several hundred of the most successful politicians in the country that the folks are beginning to worry about continued federal spending and relating it to the proposed increase in the national debt from 45 to 50 billions is important. Especially as it is being retailed, in a pontifical manner, with the coffee and cigars after Washington dinner parties.

Not only that, but it is now a certainty that there will be plenty of debates on the subject, in both House and Senate. That is assured by the President's determination to impose new taxes to take care of the additional spending for national defense, and for greater farm aid. Nobody is fooled by all the talk of cutting expenditures enough to avoid new taxation. The cutting of estimates is in progress, beyond a doubt. There are screams to high heaven from all over the various departments, even including the politically sacred precincts of agriculture.

But this is shadow boxing. Proof? The CCC camps are included in the cuts. Everybody knows that these have proved one of the most popular and least criticised expenditures the federal government has made. Congress has again and again demonstrated its approval of this particular item. It will do so again.

Why, then, is it being included in the cuts? Simply to show Congress—and the country—how very hard it is to cut federal spending—what protests will come from the country if it is attempted.

There is another reason for these so-called cuts. They will stand up, apparently, until at least the presidential primaries are over. Their collapse will not be revealed until the deficiency appropriations come before Congress, along about May or June, when Congress will be found restoring most of the appropriations it slashed in the regular appropriation bills. By that time, the White House hopes, there will be so much excitement about other things—the presidential campaign and the war possibly—that the utter failure of the "economy" program will not be front page news.

All this will be mere political maneuvering. Pay little attention to it, for it simply isn't worth it. The big thing is that Congress is not going to vote any more vast sums for new hydro plants or federal grants and loans to municipalities to subsidize competition with the electric industry —or any other industry!

This goes for the 7 TVAs, so regretfully "postponed" by the Administration a while back. It goes for the St. Lawrence Seaway, though of course that never had a chance, as pointed out in previous issues of ELECTRICAL WORLD, because of opposition in the Atlantic and Gulf states to the seaway phase of the project. (Incidentally, even Senator James Mead of New York, who so capably helped to turn the Congressional TVA investigation into a whitewash, has admitted that he will never vote to approve a St. Lawrence seaway treaty!)

And it goes for that Tate plan for a half-billion-dollar grid system in the Northeast, which threatened to supplant a lot of private electric capacity with four big government built, owned and operated steam plants!

The boys up on Capitol Hill are not taking any, thank you—Roosevelt, Ickes, Lilienthal and Carmody to the contrary notwithstanding.

Sentiment Unchanged

There is no thought here of giving the impression that there has been a big change of heart on public power in Congress. There has been a mild swing away from government ownership, but the number of men who have changed their minds on the economic essentials is very small. Two other considerations are vastly more important. A Democratic congressman cannot count this campaign on Roosevelt pulling him through. Roosevelt may not even run. If he does he will have a battle. He might win, but not with a landslide comparable to 1932 and 1936. So the congressman must figure on paddling his own canoe, so to speak, instead of being towed. Just a little while back the same congressman figured he had to stick with Roosevelt on every possible vote just to keep the towline intact.

And even more important, though related, is the spending and taxation issue. Congressmen voting for big new appropriations will run the risk of their opponents, in primary or convention, capitalizing the debt issue against them. It just won't be good politics!

NEWS OF THE WEEK

Standard Gas & Electric Sets $37,047,735 Budget

President Lynch says electric department will spend $32,718,999 and install 137,000 kw. of additional generating capacity — Preliminary figures subject to change

Preliminary and tentative construction budget for 1940 of the utility operating companies in the Standard Gas & Electric system has been set at $37,047,735, according to Bernard W. Lynch, president. Mr. Lynch said that this amount includes $5,365,152, which it is estimated will be carried over from the 1939 budget for expenditures for projects not completed this year.

It is estimated that expenditures in the electric department will total $32,718,999; gas department, $3,454,021, and in other departments, $874,715.

The budget provides for the installation of 135,000 kw. of additional generating capacity, consisting of 60,000 kw. in the James H. Reed station of Duquesne Light; 50,000 kw. by the Northern States Power Co. of Minnesota in one of its generating plants, the location of which is to be determined later; a generating station of 10,000 kw. by Northern States Power (Wis.) at La Crosse, construction of which is now in progress; a 7,500-kw. station by Northern States Power (Minn.) at St. Cloud, and the addition of 7,500 kw. by Southern Colorado Power at Pueblo.

In addition to the above installations, consideration is being given to one other project that would involve 25,000 kw. of added capacity. This project has not been included in the present budget.

Preliminary budgets for the principal utility companies in the Standard Gas & Electric system include: California Oregon Power, $1,014,162; Louisville Gas & Electric, $2,015,615; Northern States Power (Minn.) and subsidiaries, less Wisconsin utilities, $8,454,135; Northern States Power (Wis.) and subsidiaries, $1,987,560; Oklahoma Gas & Electric, $1,631,104; Philadelphia Company and subsidiaries, $15,262,428; San Diego Consolidated Gas & Electric, $2,809,905; Southern Colorado Power, $1,105,259; Wisconsin Public Service, $1,557,590. Mountain States Power budget of $695,000 is included, although the company is undergoing reorganization.

The Philadelphia Company budget of $15,262,428 does not include Pittsburgh Railway and Pittsburgh Motor Coach, now in receivership. However, included are estimated expenditures by the electric group of $12,372,684 and $2,884,744 for the gas group.

Mr. Lynch explained that the figures are subject to material changes and cannot be considered as final.

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N. Y. Board Opposes FPC's Jurisdiction

New York State Public Service Commission took open issue last week with the Federal Power Commission on the agency's attempt to obtain jurisdiction over the affairs of the Central New York Power Corp., a subsidiary of the Niagara Hudson Power Co., under provisions laid down in the Natural Gas Act.

In a letter forwarded to the Federal Power Commission in Washington, the state commission declared it was "very definitely interested in any attempt upon the part of a Federal agency to extend jurisdiction over a corporation and its affairs which under our scheme of government is engaged entirely in intrastate commerce and therefore not subject to Federal regulation. . . ." "Our experience shows that dual or duplicate regulation usually leads to unnecessary expense, litigation, conflicting orders which produce confusion and ineffective regulation."

On December 1 the FPC issued an order which required Central New York Power to show cause at a public hearing on December 20 why it should not be determined to be a natural gas company as defined in the Natural Gas Act. Hearings have been completed and counsel for both sides have been given until March 1 to file briefs.

•

Mississippi Power Completes TVA Deal

Sale by the Mississippi Power Co. to the TVA and associated co-operatives and cities of certain of its transmission, substation and distribution facilities in northern Mississippi was confirmed last week by Wendell L. Willkie, president of Commonwealth & Southern.

Mr. Willkie said that the consideration was $2,000,000, of which $1,333,000 was paid by TVA and the balance by rural co-operatives and the towns of Louisville and Philadelphia.

"The transmission lines sold to the TVA in this transaction also serve the cities of Columbus, Starkville, Aberdeen and Macon," Mr. Willkie said. "These cities had already built duplicate distribution systems with free grants and loans from the PWA and they therefore refused to buy the distribution systems of Mississippi Power. Accordingly, the company will proceed to tear down its distribution systems in those cities and recoup such amount as it can from salvage, which, of course,

will only be a small percentage of their total value."

It was pointed out by Mr. Willkie that the sale of this property was made at substantial loss to the company, but "it was apparent" that the loss would be greater if it attempted to compete with the duplicate distribution systems already built by the cities with federal funds and which would be furnished wholesale power by the TVA.

•

SEC Survey Shows Utility Locations

General headquarters of the 54 registered public utility holding companies comprising 666 electric and gas operating subsidiaries are located in seventeen cities throughout the United States, according to a survey by the Securities and Exchange Commission made public recently.

According to the survey, the headquarters for 26 systems with 345 subsidiaries operating in 48 states, or 51.8 per cent of the total number of operating companies, are located in New York, Jersey City or Newark. Eight systems, with 131 subsidiaries operating in 31 states, or 19.7 per cent of the total, have their general headquarters in Chicago.

The survey also shows that 31 of the 54 systems have operating companies located 1,000 or more miles from the general headquarters. It is also pointed out that all of the electric and gas operating companies in Alabama, Georgia, Florida, Nevada and Utah which are subsidiaries of registered holding companies have their general headquarters in New York, Jersey City or Newark.

The report was prepared by C. A. Turner under the supervision of Joseph L. Weiner, director of the public utilities division.

•

Completes Changeover

Electric current in Niagara Falls, N. Y., has been switched from 25 cycle to 60 cycle at a cost of more than $1,000,000 and without serious interruption. Buffalo Niagara Electric Corp. stated that the changeover, begun in October, 1937, was effected with an average interruption of 8⅓ minutes.

•

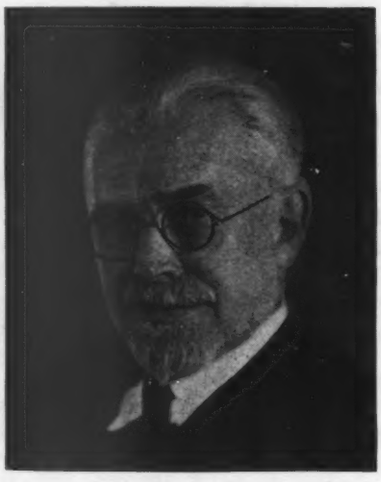
Seek TVA Power

Seven Southeast Missouri towns are seeking to obtain TVA power. Southeast Missouri Electric Development Association has been organized, with Elbert L. Ford of Kennett as president.

Henry L. Doherty Dies

Henry L. Doherty, an outstanding leader in the utility and petroleum industries and president and founder of Cities Service Co., died, of bronchial pneumonia, at 9:41 p.m. December 26 at Temple University Hospital, Philadelphia. He had suffered from arthritis since 1927 and had been a patient at the hospital periodically since 1930.

Student, inventor, economist, philosopher and financier, Mr. Doherty continued his active career, directing various engineering researches from his hospital apartment during the past few years. His dynamic energy carried him from a newsboy at 10 on the streets



of Columbus, Ohio, to the head of a billion-dollar corporation.

Mr. Doherty was born in Columbus May 15, 1870, and began his active business career at 12 as an office boy with the local gas company. At 20 he was gas company manager, chief engineer of several companies at 27, millionaire at 35 and multimillionaire at 40. He formed the firm of Henry L. Doherty & Co. in 1905 and Cities Service in 1910.

Many of the advancements in the oil, gas and electric industries are credited to Mr. Doherty. His work in the conservation of oil and its extraction is widely recognized. In the utility industry he was the first to organize the new business department for the promotion of appliances and wider use of electricity. He originated the Doherty three-part rate, the "readiness-to-serve" method of charging for gas and electric service. During the World War he turned his business enterprises over to his associates and went to Washington to give his services to his country. Largely through his efforts the American Petroleum Institute was organized.

His accomplishments in the utility industry had far-reaching effects. As a characteristic example may be cited his experience with the National Electric Light Association, which he joined in 1897. Feeling that it was lacking in influence and character, he began an aggressive campaign and was assisted in his fight by the younger element in the association, whose loyalty led them to elect him president in 1901. During his tenure of office he broadened and expanded the association's commercial, accounting and engineering functions.

Mr. Doherty guided the Society for Electrical Development from its very beginnings and was an influential factor in its policies until the early '20s.

In 1930 he was awarded the Walton Clark Medal by the Franklin Institute for his outstanding work in the gas industry. At that time he had more than 150 patents to his credit. He was given the honorary degrees of doctor of science by the University of Miami, doctor of engineering by Lehigh University and doctor of laws by Lincoln Memorial University, Cumberland Gap, Tenn.

Mr. Doherty served as chairman of the 1934-35-36-37 national committees for President Roosevelt's Birthday Ball, which sponsored a series of dances throughout the country each of those years on January 30, the President's birthday, for the benefit of infantile paralysis sufferers.

•

Challenges FPC Right

Puget Sound Power & Light Co. last week challenged the federal government's authority to require permits to import electric energy as it filed under protest an application for permission to import a small amount of Canadian power. The company stated that "neither the President nor the Federal Power Commission has any authority to require applications for or to grant permits for operating or maintaining facilities used solely for the importation to the United States and not for the exportation from the United States of electric energy."

•

Starts High-Voltage Line

Southern Canada Power Co. has started construction of a heavy capacity high-voltage transmission line from Hemings Falls to St. Cesaire, Que., from which point a branch line will connect to the existing network. The new line will increase greatly both capacity and operating flexibility of the transmission system and forms part of a program designed to meet the demands of increased loads and to provide for future load growth.

Kellogg Traces Progress of Utilities During Year

Edison Electric Institute president says industry shared fully in revival of business activity — Points to gain in power output and earnings — Drought added to expenses

The electric light and power industry shared fully in the revival of business activity in this country which took place during the year, with power output up 12 per cent over 1938, 7 per cent above the previously high year of 1937, and exceeded that of the 1929 boom year by 38 per cent, according to Charles W. Kellogg, president of the Edison Electric Institute, in a year-end review.

An outstanding feature of the year's operation was the substantial increase in output during the latter half of the year, resulting from the industrial expansion which accompanied the outbreak of the war in Europe.

Rainfall Deficient

Another feature was the serious shrinkage in water power production during the autumn months because of the progressive failure of water supply. Rainfall was deficient from the very start of the year, Mr. Kellogg said, and by September the drought became acute and the year closed with many reservoirs empty or nearly so and the streams in some areas reduced to extreme low stage.

On the other hand, Mr. Kellogg said, steam generation rose to new high records, increasing approximately 22 per cent over 1938. The steam output almost equals the entire output of electricity from all sources during 1929.

Industrial power sales were up nearly 20 per cent over 1938, while commercial sales rose 9 per cent. Domestic service showed the usual annual growth and established a new high record, being 8 per cent over 1938. The average annual use was 900 kw.-hr., against 853 in 1938.

Mr. Kellogg reported that customers increased 900,000 during the year, reaching a grand total of 28,750,000. Of the increase, 380,000 were farm customers, two-thirds of which were on REA lines.

New construction in 1939 added 1,310,000 kw. of generating capacity, of which 1,090,000 kw. was installed by the industry and 220,000 kw. by the federal government. Total generating capacity, including government, amounted to 38,600,000 kw. at the end of the year. In addition, about 670,000 kw. of capacity in industrial plants is interconnected with and contributes to the public supply of electricity.

To Add Capacity

New construction programs now planned for 1940 and 1941 will add 4,315,000 kw. of additional capacity, Mr. Kellogg said, of which amount 2,830,000 kw. of steam and 70,000 kw. of hydro will be installed by the industry and 1,415,000 kw. of hydro will be added by government projects.

Construction budgets for 1940 are estimated at $600,000,000, as against $450,000,000 in 1939.

The price of electric service was reduced again during 1939, but at a smaller rate than has prevailed during previous years, Mr. Kellogg declared. "It grows more and more difficult to reduce rates in the face of mounting operating costs, rising taxes and increased charges for depreciation." The average price was 4.07 cents per kw.-hr. for domestic service, against 4.23 cents in 1938 and 6.33 cents ten years ago.

Total revenue approximated $2,304,000,000 for 1939, an increase of $132,000,000 over 1938. Of this increase, only about $50,000,00 was carried through to net income. Taxes rose about $20,000,000 to $345,000,000, or 16.2 cents of every dollar of revenue.

•

Central Illinois Light Starts Plant Addition

Authorization has been received and construction started on a 35,000-kw. turbo-generator addition to the East Peoria plant of the Central Illinois Light Co.

The present construction schedule calls for this unit to be in operation in the early summer of 1941. The unit, as stated, has a 35,000-kw. rating and operates on a throttle pressure of 800 lb. and a throttle temperature of 850 deg. In addition to the turbine a boiler of 375,000 lb. of steam per hour capacity will be installed, according to a statement by company officials.

•

Makes Service Awards

Consolidated Edison Co. of New York has awarded seventy-eight meritorious service certificates to employees who, in the last two years, have shown outstanding bravery and good judgment in life saving and the protection of property. This brings the total number of such awards made by the Edison companies in the last twelve years to 729, of which 615 were for life saving.

PROMOTE WIRING—The Charlotte (N. C.) Adequate Wiring Bureau at a recent meeting went into details of its new promotion with a great deal of success. Standing, l. to r.—Roy A. Palmer, Duke Power Co.; A. E. Schanuel, National Adequate Wiring Bureau; Hugh Dellinger, chairman, Charles B. Miller, Jr., publicity chairman, and Norman E. Tuldal, secretary, all of the Charlotte A. W. Bureau, and Ralph Bouligny, electrical contractor

New Power Unit Ordered by Ohio Public Service

Generating and distribution equipment to cost $3,000,000 in expansion program of Ohio utility — Addition at Warren station will be put into service in 1941 — Other work planned

Orders are being placed by Ohio Public Service Co. for new generating and distribution equipment which will cost approximately $3,000,000 and which will enable the utility to provide adequate electric power for the increasing demands of industry and homes upon its lines.

T. O. Kennedy, vice-president and general manager, stated that the largest single unit involved in the new construction will be a complete generating unit consisting of boiler, turbo-generator, condenser and all auxiliaries, which will be added to the Warren generating station. The construction and installation of this new equipment, which alone will cost approximately $2,000,000, will require nearly sixteen months. The installation will be completed early in 1941.

Equipment Rating

The turbo-generator unit, which will be manufactured by Westinghouse Electric & Manufacturing Co., will be a 42,850-kva., 13,800-volt, 60-cycle unit. It is designed for variable bleed at 200 lb. for existing low-pressure steam requirements and for condensing the steam for the balance of the load requirements. The steam pressure will be 825 lb. per square inch and will have a total temperature of 825 deg. F. Construction will start at once, Mr. Kennedy said.

The boiler will produce a steam pressure of 900 lb. per square inch at 825 deg. F. total temperature. Its normal capacity will be 350,000 lb. per hour. The boiler is designed to burn pulverized fuel and the fuel equipment will be furnished by Babcock & Wilcox.

In addition to the completely new generating equipment at Warren, Mr. Kennedy said, six of the older low-pressure boilers of 200 lb. pressure are to be rebuilt. This new equipment, together with the modern topping turbine which was installed in 1938, will make the Warren plant one of the most modern in the country.

The additional $1,000,000 that Ohio Public Service has earmarked for construction expenditures in 1940 will be spent for distribution equipment and transmission line rebuilds in practically every division of the company's properties. Power plant equipment in Lorain will be modernized; a new substation will be constructed in Warren to provide for the demands of the Copperweld Company, which is building a new $2,000,000 plant in the city; other substation equipment in Sandusky and elsewhere will be rebuilt to provide better service to all company customers, and several new rural extensions will be built.

Mr. Kennedy said that industrial customers in the northern Ohio area have been experiencing a considerable expansion in their business and the new construction work planned by Ohio Public Service is in line with the company's policy to keep constantly abreast of the industrial, commercial and residential needs of its customers.

•

Associated Gas to Sell $7,000,000 of Properties

The investment banking house of Rupe & Son of Dallas, Texas, has completed negotiations for the purchase of $7,000,000 of public utility properties from Associated Gas & Electric Co. Properties involved include those of Arkansas General Utilities Co., the Louisiana Public Utilities Co., Inc., the Texas General Utilities Co. and the Panhandle Public Service Co. of Oklahoma.

Mr. Rupe said that the plan contemplated formation of a single operating company to be headed by Glenn C. Hyde, formerly president of the Southern Ice & Utilities Co. of Dallas, now vice-president in charge of ice property operation for the Utility Management Corp.

•

Rate Case Hearing Set For Arkansas Utilities

Finding that it is necessary, desirable and in the public interest, the Federal Power Commission, on its own motion, has ordered that hearing be held February 26, concerning the lawfulness of proposed increased rates to be charged by Arkansas - Missouri Power Co. to the Arkansas Utilities Co. for electric energy for resale, and the lawfulness of proposed increased rates to be charged by Arkansas Utilities Co. to Missouri Utilities Co., also for electric energy for resale.

At the same time, the commission ordered that pending the hearing the proposed increases should be suspended for a period of not more than five months. During the period of suspension, the rates and charges now in effect will remain in force, but the order does not suspend or otherwise affect the proposed new rates charged to either Arkansas Utilities Co. or Missouri Utilities Co. for electric energy other than for resale.

•

Utilities and Co-ops Sign EHFA Contracts

Electric Home and Farm Authority has announced that contracts had been closed with the Yellowstone Valley Electric Co-operative, Inc., Huntley, Mont.; Flathead Electric Co-operative, Inc., Kalispell, Mont.; Benton Rural Electric Association, Prosser, Wash.; Red River Valley Co-operative Power Association, Halstad, Minn.; Lower Colorado River Authority, Austin, Tex., and the City of Scottsboro, Ala. Contracts provide for co-operation in financing the sale of electric appliances.

Contracts have been also closed with the city of Lakeland, Fla., and the Northwestern Electric Co., Portland, Ore., covering financing the wiring or rewiring of existing homes and farms. EHFA announced that a contract had been closed with the Virginia Public Service Co., Alexandria, providing for co-operation in financing the sale of appliances.

•

Celebrates Half Century

Last week Stone & Webster, Inc., celebrated fifty years of operation. The company was founded by Charles A. Stone and Edwin S. Webster, two graduates of Massachusetts Institute of Technology. The company, in its half-century of business, has completed construction work in excess of $1,000,000,000 and has appraised properties having a total valuation of approximately $12,000,000,000.

•

Hetch Hetchy Appeal

The United States Government has asked the U. S. Supreme Court to reverse the decree of the appeals court which in effect approved the contract entered into by the city of San Francisco with the Pacific Gas & Electric Co. for sale of Hetch Hetchy power.

Slattery Views REA As Aiding Farmers

Through the efforts of REA and of the utilities, electric central station service has been made available to more farm people during the 4½ years since REA was established than in the preceding three decades since rural electrification had its beginnings in the United States, according to Harry Slattery, REA Administrator.

Speaking before the District of Columbia chapter, National Lawyers Guild, Washington, D. C., Mr. Slattery said that electricity has become a necessity on the farm and its wide use will increase farm income by making operations more profitable.

•

Modern Kitchen Bureau Names Contest Winners

The Modern Kitchen Bureau has announced the winners in the third quarterly contest for electric water heater salesmen.

Henry H. Orr, Jr., Duke Power Co., Greenville, S. C., won first prize; Ira Sanders, of Frank's Department Store, Fort Wayne, Ind., second prize; Frances L. Duffy, Public Service Co. of Northern Illinois, Chicago, third prize and Miss Harriet Wallace, Idaho Power Co., Russell W. Halligan, Boston Edison Co., and H. E. Reed, F. L. Dallenbaugh and John Boyd, all of Idaho Power Co., each a fourth prize.

•

Aluminum Company Signs Bonneville Power Contract

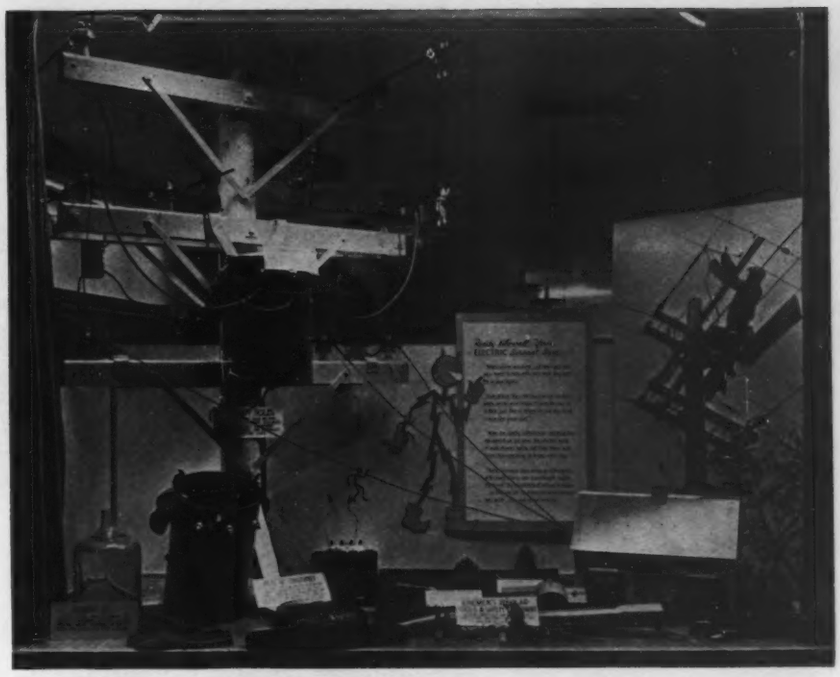
Aluminum Company of America has announced a "several million dollar" metal-producing plant to be built at Vancouver, Wash., to "take care of an increased demand for aluminum on the West Coast."

Dr. Paul Raver, Bonneville Administrator, said that the company had signed a contract for 32,500 kw. of power, which is the first industrial contract completed and represents the largest power purchase yet negotiated. At present Bonneville has a capacity of 86,000 kw. The capacity will be more than doubled during 1940 when two more generators are installed.

•

Free Meter Tests

The Tampa (Fla.) Utility Board has given notice that after January 15 the Tampa Electric Co. and Tampa Gas Co. must limit their connection charges to 50 cents and make free meter tests whenever customers demand. A customer cannot receive a second free meter test within six months of the first.



POPULAR DISPLAY—This window featuring "typical" transformer pole top and display of lineman's tools has attracted widespread attention and comment among customers at the Indianapolis Power & Light Company

•

New Mexico Utility Sells System to Town of Gallup

The New Mexico Public Utilities Corp. has sold its distribution system, franchises and good will, which comprised all holdings in Gallup, McKinley County, to the town of Gallup. The corporation is being dissolved in New Mexico.

The property is now under management of a utility commission composed of R. R. Rogers, chairman; J. E. Lieberman, J. W. Eichman and J. H. Thatcher. C. M. Sabin is secretary and R. H. Haggard, manager.

•

Tennessee Loses Taxes

Representative Estes Kefauver has estimated that eleven counties in the third Tennessee congressional district will suffer an annual tax loss of $544,148 as a result of public power operations and the TVA power program. He said that municipalities would lose another $162,970 and school districts $808. It was estimated that the state will have tax losses resulting from acquisition of private utility properties of $870,000.

El Paso Electric Seeks to Export Electricity

El Paso Electric Power Co., El Paso, Texas, has filed with the Federal Power Commission application for a Presidential permit, in compliance with Executive Order No. 8202, for the transportation of electric energy between the United States and Mexico.

El Paso & Juarez Traction Co. is a Texas corporation operating traction lines in the city of Juarez, Mexico, just across the boundary line from El Paso. Contract exists between the two named companies for joint operation of the El Paso, Tex.-Juarez, Mex., street car lines and the international toll bridges. The application states: "Neither the company nor its transmission lines are owned wholly or in part or directly or indirectly subventioned by any foreign government; nor has the company any understanding for such ownership by or subvention from any foreign government."

•

Toledo Gets Option

The City Council has advised Toledo Edison Co. that it must grant the city an option to purchase its $70,000,000 plant before it will sign a new rate contract. The utility has offered a rate cut of $498,000 annually, but a citizens' advisory group has recommended a cut of $1,250,000.

Northwest Light-Power Group to Hold Meeting

The annual Business Development meeting of the Northwest Electric Light and Power Association will be held at the Olympic Hotel, Seattle, Wash., February 29 and March 1, according to C. Patrick Johnson, section chairman.

Three one-half day general sessions will be held, at which all aspects of sales work and business development will be discussed and one half-day session devoted to concurrent bureau and committee conferences.

The bureaus which will meet separately in these conferences, with their chairmen are: commercial and industrial sales, J. A. Lockhart, Pacific Power & Light Co.; residential sales, J. F. McAllister, Utah Power & Light Co.; rural sales, J. C. Scott, Puget Sound Power & Light Co., and advertising, John Dierdorff, Northwestern Electric Co.

•

Galveston to Get Central Air Conditioning System

Galveston, Texas, is to have the first air-conditioning system in the United States to be operated as a public utility. P. E. Nicholls, Jr., recently obtained a 50-year franchise from the city council to construct a plant, to be started not later than June, 1940, which will supply the downtown business area.

The distribution system will be operated from a central steam generating plant where a vacuum jet cooler will be installed. Cold water will go out from the plant through underground mains, circulating through air-conditioning units in various buildings and then return to the plant for recooling.

•

Plan Rural Conference

Announcement has been made that the eleventh conference on farm electrification will be held January 8-9 at Purdue University under the direction of Purdue University Agricultural Experiment Station and Agricultural Extension Department co-operating with the Indiana Electric Association and the U. S. Department of Agriculture.

•

Signs Bonneville Contract

The city of Canby, Ore., having its own municipal distribution system and a long-time wholesale customer of Portland General Electric Co., became the third municipal customer of Bonneville on December 22 by the execution of a 20-year contract for 300 kw. Portland General Electric has agreed to transmit the power until Bonneville can extend its own line to the city.

•

Buys Local System

The city of Lockhart has purchased from the Lower Colorado River Authority the local electric distribution system for $140,000. The system was acquired by the Authority from Texas Power & Light Co. several months ago. LCRA will furnish the energy.

•

Utility Contract Approved

A five-year contract for sale of electrical energy between the Cleveland Electric Illuminating Co. and the Ohio Edison Co., in Cleveland, effective December 1, has been approved by the Ohio Utilities Commission.

MEETINGS

American Engineering Council—Annual meeting, Mayflower Hotel, Washington, D. C., January 11-12.

Public Utilities Advertising Association—Annual western conference, Hotel Cosmopolitan, Denver, Colo., January 12-13. Publicity Committee, P.U.A.A., Room 1704, 4 Irving Place, New York, N. Y.

Louisiana Engineering Society—Annual meeting, St. Charles Hotel, New Orleans, La., January 12-13. A. M. Hill, secretary-treasurer, 422 St. Charles Hotel.

Canadian Electrical Association—Annual winter conference, Montreal, Que., January 15-16. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal.

American Society of Refrigerating Engineers—Annual meeting, Cleveland, Ohio, January 22-26.

American Institute of Electrical Engineers—Winter convention, New York, N. Y., January 22-26. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

American Society of Heating and Ventilating Engineers—Annual meeting and International Heating and Ventilating Exposition, Lakeside Hall, Cleveland, Ohio, January 22-26. Charles F. Roth, president International Exposition Co., Grand Central Palace, New York.

Iowa Public Utilities Association—Annual sales and distribution school, Hotel Fort Des Moines, Des Moines, Iowa, January 29-30. Herbert Henderson, secretary, Security Building, Cedar Rapids, Iowa.

Edison Electric Institute—Prime movers committee, Detroit, Mich., February 5-6; electrical equipment committee, Netherlands-Plaza Hotel, Cincinnati, Ohio, February 12-13.

National Electrical Manufacturers Association—Mid-winter Conference, Waldorf-Astoria Hotel, New York, N. Y., February 5-9. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

American Institute of Mining and Metallurgical Engineers—Annual meeting, February 12-15, New York, N. Y. A. H. Parsons, secretary, 29 West 39th St., New York, N. Y.

Missouri Association of Public Utilities—Annual convention, Elms Hotel, Excelsior Springs, Mo., April 17-19. Jesse Blythe, assistant secretary, Merchants Bank Bldg., 101 West High St., Jefferson City, Mo.

Electrochemical Society—Spring meeting, Galen Hall, Wernersville, Pa., April 24-27. Dr. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Common Dividend Passed by Niagara Hudson Power

Directors of Niagara Hudson Power Corp. at their meeting last week took no action on the dividend on the common stock, although they declared the regular dividends on the preferred stocks. Alfred H. Schoellkopf, president, stated that this action was due to the necessity of conserving the cash resources to help finance the large capital expenditures required for new construction and extensions which will be needed to meet the increasing demand for power.

It was pointed out by Mr. Schoellkopf that earnings for 1939 are estimated to be about the same as in 1938, although gross will be higher. Increased operating expenses, caused mainly by the country-wide drought, which greatly curtailed the output of many hydro-electric plants located in northern New York State, offset much of the increase in gross revenue. The lack of power forced the system to make greater use of its steam plants.

•

Oklahoma Seeks Way to Obtain State TVA

A drive for a state constitutional amendment to open the way for direct purchase by consumers of electricity from the federal hydro-electric project in Oklahoma, similar to the TVA plan, has been started.

Albert McRill, attorney and former city manager, declared that a state-wide organization is being set up to circulate an initiative amendment either on a special election or in the general election next November.

•

Opposed "All Lights On"

In paid newspaper advertisements last week Detroit Edison Co. opposed the suggestion that every one turn on all his lights on Christmas Eve to prove that "there is no blackout here." The utility cautioned against such a move on the basis that "the extraordinary use of current might blow fuses in house wiring with inadequate fuses and otherwise cause trouble in some locations."

•

Set Date for Suit

The condemnation suit brought by public utility district No. 1 of Cowlitz County against the Washington Gas & Electric Co. will begin in federal court in Tacoma on January 30.

All-time Peak Goes 11.8% Over Year Ago

Previous records for the winter peak of energy production by the electric light and power industry were far surpassed in the week ended December 23, with an output of 2,641,458,000 kw.-hr., according to the Edison Electric Institute. The excess of 11.8 per cent over the like week a year ago points to a continuation of the lead that has prevailed, with moderate variations, throughout the year now drawing to a close, averaging about 12 per cent.

It gives promise, also, of a flying start in 1940 over 1939, with the implication of a further speeding up of the wheels of industry.

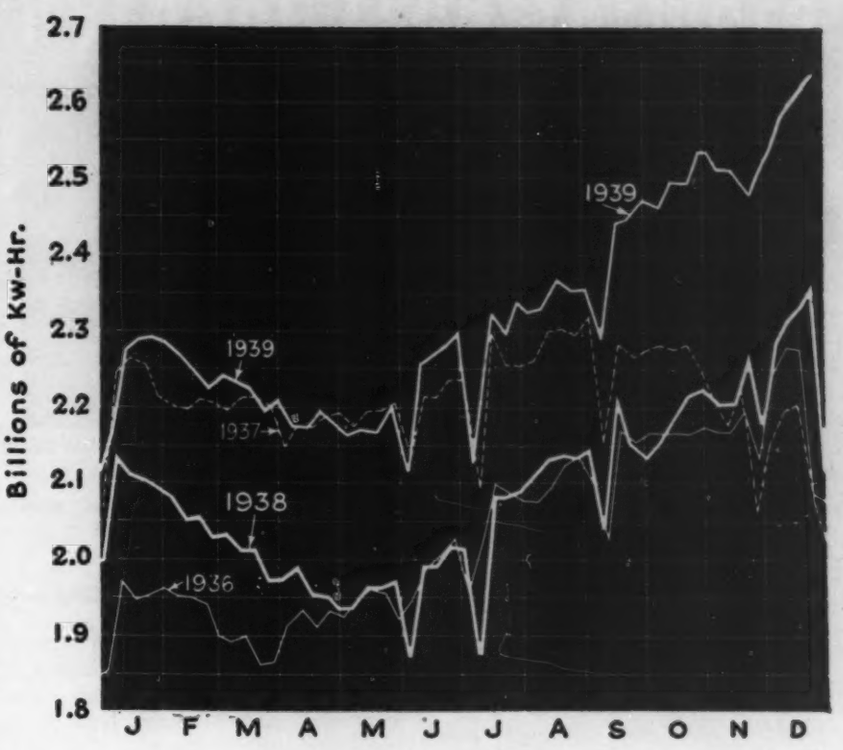
A review of these weekly figures gives little support to the impression that the outbreak of war in Europe provided any marked stimulus; the percentages were only slightly, if at all, greater in the last four months than in the earlier part of the year. If there was any such influence its duration was brief; gains were a little above the average after the middle of September, but within two months had dropped to the previous level, which was subsequently maintained.

Weekly Output Millions Kw.-Hr.

1939		1938		1937	
Dec. 23	2,641	Dec. 24	2,363	Dec. 25	2,085
Dec. 16	2,605	Dec. 17	2,333	Dec. 18	2,202
Dec. 9	2,586	Dec. 10	2,319	Dec. 11	2,196
Dec. 2	2,539	Dec. 3	2,286	Dec. 4	2,153
Nov. 25	2,482	Nov. 26	2,184	Nov. 27	2,065
Nov. 18	2,514	Nov. 19	2,270	Nov. 20	2,224

Per Cent Change from Previous Year

	Week Ending		
	Dec. 23	Dec. 16	Dec. 9
New England	+10.3	+12.1	+ 9.7
Middle Atlantic	+ 8.1	+ 8.4	+ 8.7
Central Industrial	+15.8	+15.4	+14.6
West Central	+ 7.8	+ 7.8	+ 5.9
Southern States	+12.0	+12.1	+11.7
Rocky Mountain	+ 3.3	+ 5.2	+ 8.0
Pacific	+ 8.9	+ 7.4	+ 8.7
United States	+11.8	+11.6	+11.5



Artistic Lighting Display to Feature Texas Project

Plans and recommendations have recently been completed by the lighting section of the San Antonio Public Service Co., San Antonio, Texas, for outdoor lighting in connection with the San Antonio River Beautification Project. Cost of this work is estimated to be about $10,000. Recommendations call for a total of 316 lighting units averaging 174 watts each. This represents a load of 54,968 watts. Provision is made for the use of 32 different types of fixtures, including floodlights, fluorescent, mercury-vapor and special lamps for under-water effects.

Special color effects are to be achieved through artistic light application in trees, shrubbery, buildings and stonework along the river banks and high-mounted incandescent floodlights to furnish soft, general illumination.

•

Outsells Lighting Quota

Public Service Company of Indiana recently completed a ten-week lighting drive which netted approximately $80,000 E.A.R. During the campaign employees sold a total of 6,244 I.E.S. lamps, 8,800 pin-up lamps and 142,504 Mazda bulbs, representing a combined lighting load of $65,041 a year, or 136.7 per cent of quota. An additional $13,928 of estimated annual revenue was obtained by commercial sales. Last year the campaign produced approximately $49,000.

•

Giants Get Floodlights

One of the most powerful floodlighting systems on any sports field in the world will be installed next year at the Polo Grounds, home field of the New York Giants. The club has ordered the Westinghouse Electric Supply Co. to install a series of 836 floodlights of 1,500-watt capacity.

•

Illinois Electric Sales

Total sales of energy to ultimate consumers by eleven large electric utilities in the state of Illinois amounted to 653,539,203 kw.-hr. in October, compared with 566,963,862 kw.-hr. for the same month last year. This is a 15.3 per cent increase. Comparison of the current month's sales with those for September reveals an increase of 5.1 per cent.

•

Study St. Lawrence

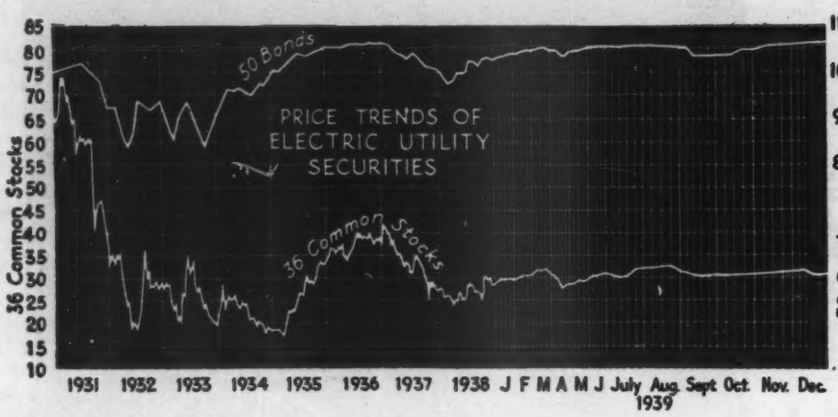
The Department of Commerce has started a study of the possible effects of development of the St. Lawrence seaway and hydro-electric project. Participating in the study are the Departments of Commerce and Agriculture, the Maritime Commission, the Corps of Engineers, the Federal Works Agency and several private individuals.

•

October Canadian Output

Power production by Canadian central electric stations in October totaled 2,598,956,000 kw.-hr., in increase of 10.9 per cent over a year ago and a new high record for all time. In the previous month output was 2,380,651,000 kw.-hr. and a year ago 2,333,461,000 kw.-hr. Exports to the United States in October were 151,794,000 kw.-hr., compared with 159,713,000 kw.-hr. in September and 165,455,000 kw.-hr. in October last year.

Securities Drift Within Narrow Range


50 Bonds
PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
36 Common Stocks
36 Common Stocks
50 Bonds
1931 1932 1933 1934 1935 1936 1937 1938 J F M A M J July Aug. Sept Oct. Nov. Dec. 1939

Following the general market trend, electric light and power stocks moved within narrow limits this week. "Electrical World" stock index remained unchanged at 31.5; last year, 28.6. The bond index also remained unchanged at 106.1

New Utility Issues Total $17,650,000

Two new utility offerings were placed on the market last week and met with active investment demand, both going promptly to premiums.

Pennsylvania Water & Power Co. issued refunding mortgage and collateral trust bonds, 3¼ per cent series due 1964, to the amount of $10,900,000. The bonds were priced at 104 and accrued interest. Net proceeds will be applied to the payment of $10,903,000 principal amount of first mortgage 5 per cent sinking fund gold bonds, due January 1, 1940.

Southwestern Light & Power Co. made an offering of first mortgage bonds, series A, 3¾, due December 1, 1969, priced at 102 per cent and accrued interest. The issue involved a total of $6,750,000. Net proceeds will be applied, together with other funds of the company, to the redemption at 102½ and interest, of first mortgage 5 per cent gold bonds, series A and series B.

•

Detroit Edison Dividend

Directors of Detroit Edison Co. have declared a final dividend for the year of $2 on common, out of surplus and net profits, payable January 15 to stock of record December 29. The company made a similar payment on January 16.

•

Winnipeg Electric Refunds

Winnipeg Electric Co. announces it will redeem its 4½ per cent first mortgage first series $3,500,000 bonds now outstanding and replace them with a new issue of $3,500,000 first mortgage 3½ per cent bonds, first series. The new bonds will be dated January 2, 1940 to mature January 2, 1960 and will be priced at $100 to yield 3½ per cent, payable in Canadian money.

•

American Gas Files Securities with SEC

American Gas & Electric Co. has filed a registration statement, covering an aggregate of $30,000,000 of sinking fund debentures and 355,623 shares of cumulative preferred stock, $100 par value. The sinking fund debentures consist of: $8,000,000 due January 1, 1950; $10,000,000 due January 1, 1960; and $12,000,000 due January 1, 1970. Proceeds from the sale, together with treasury funds of the company, will be used to redeem outstanding debentures and 355,623 shares of $6 preferred stock, no par value.

The company will offer to the holders of its old preferred stock the privilege of exchanging their stock for shares of the cumulative preferred stock on the basis of one share of the cumulative preferred stock for each share of old preferred stock exchanged, plus a cash payment equal to the difference between the redemption price per share of the old preferred stock and the initial public offering price per share of the cumulative preferred stock and accrued dividends from January 1, 1940, to the closing date.

SEC has granted an application of the North American Gas & Electric Co. for permission to record the transfer to it of the assets of the North American Management Co., a wholly owned subsidiary, which was dissolved on June 12.

Oral argument scheduled to have been held on the application of Jersey Central Power & Light Co. for an order that it is not a subsidiary company within the terms of the Holding Company Act, has been postponed at the request of the company to January 3.

SEC has consented to the withdrawal by International Utilities Corp. of an application filed under the Holding Company Act for approval of an investment program. The commission also consented to the withdrawal by International Utilities Corp., General Water Gas & Electric Corp. and Securities Corporation General of an application filed under Section 11 (e) of the Holding Company Act in connection with a plan of simplification.

•

Cities Service P. & L. Pays Dividend Arrears

Directors of the Cities Service Power & Light Co. have authorized dividends of $10 a share on the $5 preferred, $12 on the $6 preferred and $14 on the $7 preferred stock. The declarations represent two years' accumulated dividends on each issue.

The last previous payments on the preferred stocks of the company were the regular monthly distributions of 58 1/3 cents on the $7 series, 50 cents on the $6 and 41 2/3 cents on the $5 made on June 15, 1932.

Before the recent declarations the arrearages on the stocks were $37.50, $46.50 and $52.50.

•

Calls Bonds for Payment

Public Service Co. of Colorado, successor to the Denver Gas & Electric Light Co., has called for payment on May 1, 1940, all of the outstanding first and refunding mortgage sinking fund bonds, due 1951, of the Denver Gas & Electric Light Co., at 105 and accrued interest.

•

Note Issue Authorized

SEC has authorized issuance and sale of $3,000,000 of 3½ per cent unsecured notes by Niagara Hudson Power Corp. to a group of six banks.

Utility Reports

	Net Income 1939	1938
*Central Arizona Lt. & Pwr.	$855,089	$766,136
*Detroit Edison and subs.	9,809,489	7,289,848
*Kansas Gas & Electric....	1,165,120	1,273,217
†Key West Electric.....	39,372	34,876
*Minnesota Power & Light	1,351,452	1,100,849
*Nebraska Power	1,805,428	1,881,460
†Northwestern Electric	569,944	476,402
†Pacific Power & Light.....	924,393	824,819
*Public Service of New Jersey and subs.....	26,624,231	22,443,432
*Superior Water, Lt. & Pwr.	120,075	99,200
*Texas Electric Service....	1,329,832	1,170,946
†Western Public Service and subs.	172,160	201,424

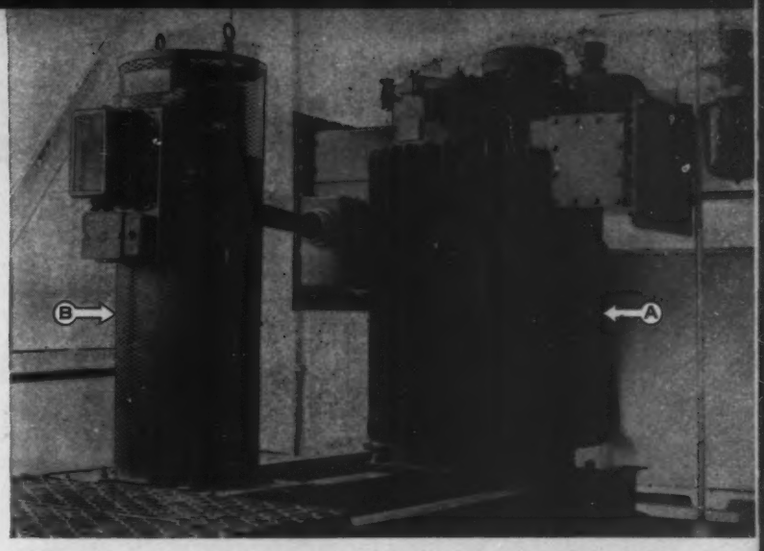
*Twelve months ended November 30.
†Twelve months ended October 31.

Specify G-E Pyranol Transformers for All INDOOR Installations

You can install them right at the load center, without costly vaults, because Pyranol is noninflammable

Use Them to Modernize Your Lighting Circuits

THINKING of improving the lighting in one of your buildings? Maybe you can save your present wiring by dividing the circuit into several sections and installing a G-E Pyranol transformer at the center of each section. Keep your present secondary wiring and run small 2300-volt primary copper to serve the transformers. Savings as high as 40 per cent have been made by this method. The technique is completely described in Bulletin GEA-3180. Ask your G-E representative for complete information on Pyranol transformers to meet your requirements, or write General Electric Co., Schenectady, N. Y.



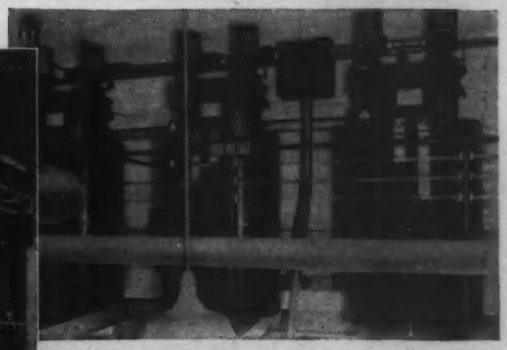
G-E Pyranol transformer (A) installed near the ceiling at the center of a modernized lighting circuit. G-E air-cooled regulator (B) provides precise voltage control for the lamps

Use Them for Your Power Circuits and Enjoy the Benefits of Load-center Distribution

(Right) Load-center distribution at Jones & Laughlin Steel Corporation plant. Note locations of G-E Pyranol transformers right at the load, with no enclosing vaults

(Above) At the Boston Woven Hose & Rubber Company plant, marked savings were made because it was possible to install G-E Pyranol transformers in the nonproductive area right under the floor

(Right) G-E Pyranol transformers saved the day for us at our Pittsfield Works. Three 635-kva Pyranol transformers located right beside heavy-current-consuming resistance-welding machines on an upper floor cut costs and losses



By mounting th Pyranol transfo ers on steel be above the fl level, Acme Br eries, San Francis conserved fl space in its eng room. Savings installed cost w nalized because vault was neces

GENERAL ELECTRIC

OPERATING PRACTICES

Alabama Develops Three-Purpose Truck

By W. P. POSTELL
Manager of Shops and Transportation
Alabama Power Company, Birmingham

Survey of the truck needs of Alabama Power Company indicated that one truck body, properly designed, would serve for transmission, distribution and substation maintenance.

In designing the body these ideas were kept continually in mind: (1) Crew must be taken care of adequately; (2) there must be enough boxes, compartments, etc., to take care of the necessary equipment and materials, but not so much room as to encourage the collection of junk; (3) consistent with the strength required, weight must be held to a minimum; (4) special equipment, such as winch, derrick, sheave blocks, bolster, etc., that would facilitate the work would be furnished with the body, but none would be added or removed except on special authorization; (5) even when loaded, the truck must present a neat and attractive appearance.

The crew cab is 7 ft. wide (the width of the body) and 5 ft. long; it is equipped with sponge rubber, canvas-covered seats on three sides to accommodate six men. Under the front seat is the winch and under the side seats are compartments opening on the outside of the body. A door in the rear of this cab is closed by a canvas drop curtain in inclement weather.

On the left side of the cab is a ladder compartment; above this is a compartment for holding flashlights, test sets, rubber gloves, etc. On the right side is a compartment for rubber hose, blankets, pigs, etc.; above this is one for switch sticks. Under the rubber goods compartment is a compartment partitioned off to accommodate small parts; above it is a compartment similar to the one on the left side of the cab. Sliding windows between the driver's cab and the crew cab allow communication between the two; a window above the line of the driver's cab gives a view of the road.

Provision is made at the rear of the body, at the center and also at each rear corner so that a universal sheave block can be used; the corner pockets are the same used for the removable stake section. A removable rope rack is provided, the foot sitting in a socket in the floor and the upper end in a socket fastened on the right-hand end of the crew cab, placing the ropes and blocks in the uncovered section of the body. For protection against rain, a treated canvas envelope, open at bottom and one side, is provided.

The Alabama Power Company

Crew and tools are kept covered in specially designed three-purpose maintenance truck

Courtesy International Harvester Co., Inc.

Six-man crew cab forward (top) contains 15,000-lb. single-line winch under front seat and numerous tool and equipment compartments. Open space in rear—7 ft. square—is for transport of heavy electrical equipment, has corrugated floor with novel nonskid surface. Door above trailer-hitch step leads to "possum belly"—9 in. deep, 24 in. wide, 12 ft. long—for storing 23-ft. sectional steel derrick, digging spoons and long bars. Cable guy type derrick (left) can be erected by one man in addition to driver and has 2-ton capacity. Six 16-ft. pike poles are carried in two sheet metal containers running lengthwise under the truck; rectangular openings may be seen on either side of step. Body over all is 7 x 12 ft.

Making a Voltage Survey?

Here's a NEW Recorder for That Job

IT'S INKLESS, IT'S LIGHTWEIGHT, IT'S LOW-PRICED
(ONLY 12 LB)

SPECIAL
FOR VOLTAGE SURVEYS

To attain still higher accuracy over a wide temperature range, Type CF-1 voltmeters are stocked as single- and double-range instruments (rated 0-140 and 0-140/0-280 volts) with temperature compensation for the 0-140-volt range.

THIS new INKLESS recorder —General Electric's Type CF-1—gives accurate, easy-to-read records under all ordinary conditions and also in many cases where ink recording is unsatisfactory. It's a sturdy inexpensive recorder, and its special features make possible many advantages.

NO INK TO SPILL — NO PEN TO CLOG

Because it's inkless, there's no possibility of "painted" or blurred records. No worry about ink evaporation or freezing—you can be sure of successful operation in temperatures from —10 F to 120F. And, under extremely fluctuating loads (where ink recorders would "paint" the chart or blur), you're assured accurate records of actual operating conditions.

WEIGHS ONLY 12 POUNDS

The Type CF-1 is small and light. It is less than half the weight of the conventional recorder. It's easy to carry, easy to handle.

FOR OUTDOOR OR INDOOR SERVICE

You can put these recorders to work inside or outside, as portables, or mount them on walls or on poles. And, where frequent servicing is impractical, they offer the advantage of continuous and service-free operation for as long as 30 days. Complete details are contained in Bulletin GEA-3187. Call the nearest G-E office or write General Electric Company, Schenectady, New York.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

does not build its own bodies, but contracts the work to established body builders, who are furnished prints and specifications. To date the majority of these bodies have been built by the Alabama Truck Equipment Company of Birmingham, which has worked very closely with the Alabama Power Company in developing this body.

•

Install Limiters on L. V. Networks—IV

By C. P. XENIS and E. WILLIAMS

Consolidated Edison Company of New York, Inc.

Paper-insulated lead-covered cables are connected to the various types of crab joints in this manner:

(A) Non-fusible crab joint installation:

1. Non-fusible crab joint terminal with rubber insulation having roll-back feature.
2. Non-fusible crab joint terminal with rubber insulation having capped end.
3. Paper-insulated, lead-covered cable.
4. Roll back rubber insulation to expose tubular copper terminal of crab joint.
5. Install rubber wedge to hold rolled back rubber insulation in position.
6. Cut back rubber insulation on capped terminal to expose tubular copper terminal.
7. Remove all traces of rubber insulation from inside and outside of tubular copper terminal.
8. Remove insulation and clean strands thoroughly.
9. Cut back lead sheath.
10. Make compression joint with press, confine indentations to length "Y." Make one indentation for 200,000-circ.mil cable; make two indentations for 350,000 or 500,000-circ.mil cable.
11. Clean lead sheath.
12. Install oil seal as follows:

(a) Build up between lead sheath and end of crab joint terminal (1½ in. length) with silk tape.

(b) Apply one thin, even coat of G.E. 1201 "Glyptal" lacquer to crab joint terminal, silk tape and lead sheath (length equal to "Z" plus 2¼ in.). Allow Glyptal lacquer to dry until tacky.

(c) Apply four half-lapped layers of silk tape with a coat of Glyptal lacquer between each layer. Allow each coat of Glyptal lacquer to dry until tacky before applying the next layer of tape.

(d) Apply coat of Glyptal lacquer to final layer of silk tape.

13. Unroll rubber insulation.
14. Roughen rubber insulation with abrasive cloth. Apply thin, even coat of rim cement. Brush off excess cement and allow to dry one minute before applying tape.
15. Apply thin, even coat of rim cement and allow to dry one minute before applying tape.
16. Apply Kerite or Uskorona tape half-lapped with sufficient tension to reduce its width from ¾ to ½ in. See table for amount of tape required.
17. Cover entire crab joint and rubber tape (Kerite or Uskorona) with two half-lapped layers of friction tape applied with considerable tension in order to compress under layers of rubber tape.
18. Finish by applying one coat of U. S. Rubber Products Co. rubber expansion joint paint or equal over friction tape.

(B) Fusible crab joint installation:

1. Fusible crab joint rubber insulation.
2. Fusible crab joint tubular copper terminal.
3. 200,000-circ.mil paper-insulated, lead-covered cable.
4. Cut back lead sheath.
5. Remove insulation and clean strands thoroughly.
6. Make compression joint with press. Make one indentation for 200,000-circ.mil cable, confine indentation to 1 in. length.
7. Clean lead sheath.
8. Install oil seal as follows: (Same procedure as for non-fusible crab joint.)
9. Apply ¾ in. asbestos tape half-lapped. Build up flush with surface of crab joint shell. Woven asbestos sleeve or sheet may be used instead of tape if more convenient.
10. Roughen rubber insulation with abrasive cloth. Apply thin, even coat of rim cement. Brush off excess cement and allow to dry one minute before applying tape.
11. Apply thin, even coat of rim cement and allow to dry one minute before applying tape.
12. Apply 21 feet (approx. ¾ roll) of Kerite or Uskorona tape half-lapped with sufficient tension to reduce its width from ¾ to ½ in.
13. Cover entire crab joint and rubber tape (Kerite or Uskorona) with two half-lapped layers of friction tape applied with considerable tension in order to compress under layers of rubber tape.
14. Finish by applying one coat of U. S. Rubber Products Co. rubber expansion joint paint or equal over friction tape.

ED. NOTE—This is the fourth in a series of four articles on this subject.

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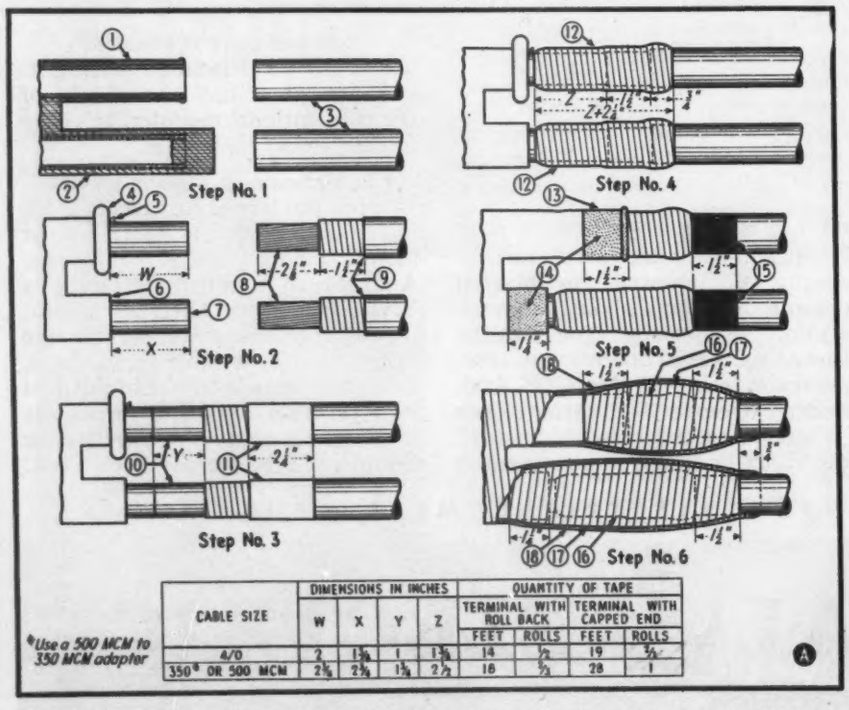
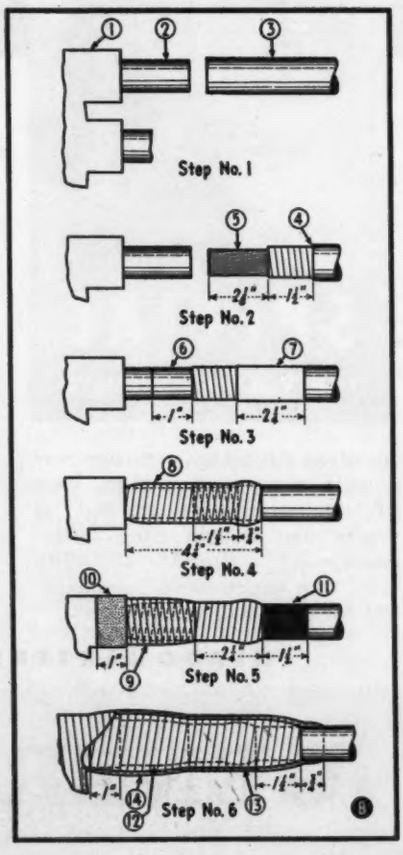
Larger Safety Clamp Holds Line Blankets

Common practice among utility linemen is the use of a 6-in. clamp type wooden clothespin to hold rubber blankets on conductors. Size of



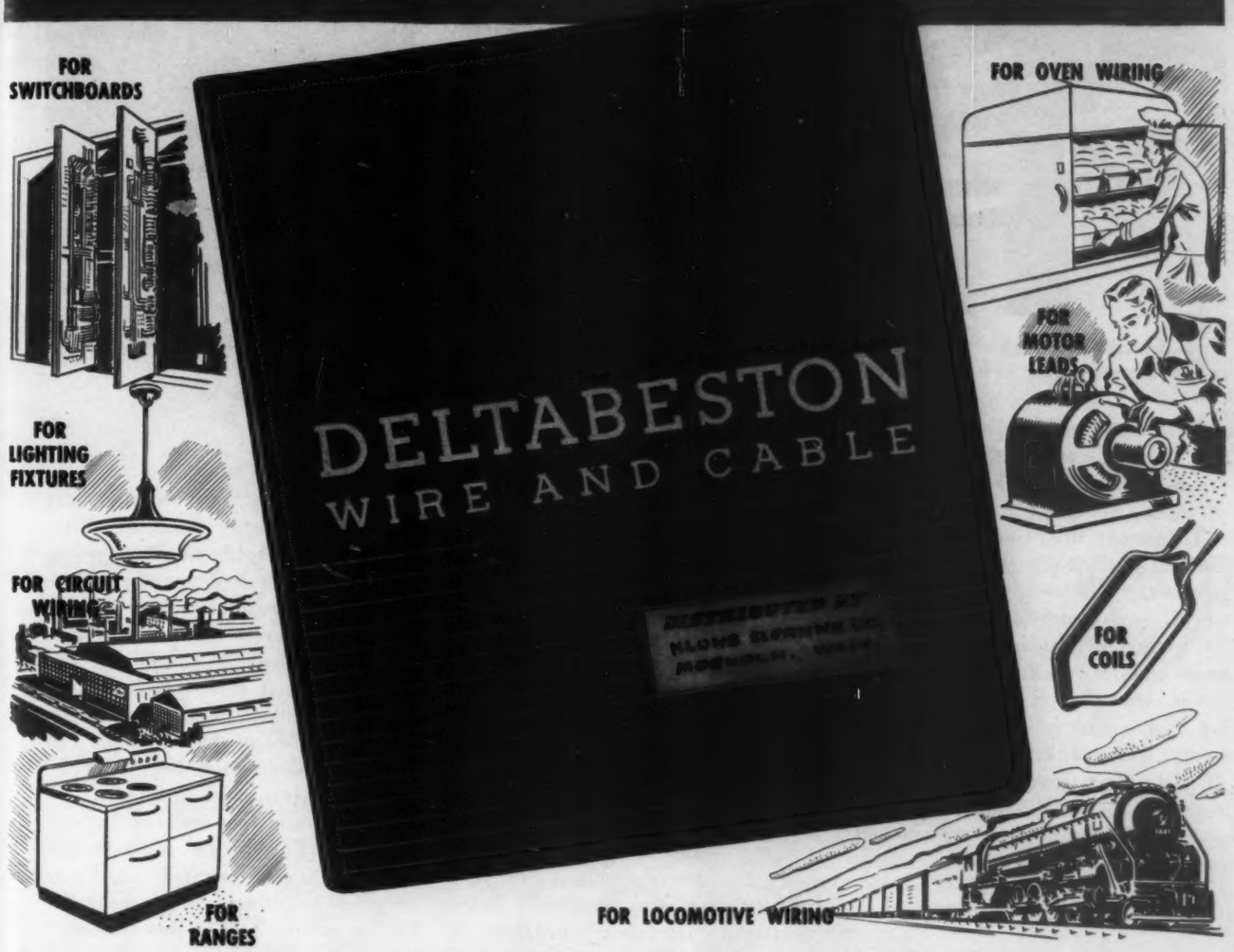
CABLE SIZE	DIMENSIONS IN INCHES				QUANTITY OF TAPE			
	W	X	Y	Z	TERMINAL WITH ROLL BACK		TERMINAL WITH CAPPED END	
					FEET	ROLLS	FEET	ROLLS
4/0	2	1⅜	1	1⅜	14	½	19	½
350* OR 500 MCM	2⅛	2⅛	1¾	2½	18	½	28	1

*Use a 500 MCM to 350 MCM adapter



Crab joint installations on paper-insulated, lead-covered cables: (A) Non-fusible; (B) Fusible

MAKE SURE THIS NEW DELTABESTON CATALOG IS ON YOUR DESK



You can solve the "heat problem" in your electrical system or your product—once and for all—with Deltabeston Wires and Cables.

In the first place, Deltabeston Heat-resisting Insulations won't fail in the face of severe treatment. Service is secure. Breakdowns due to insulation failures are few and far between.

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Remember, too, that the Deltabeston Line is extensive. It's a simple matter to select the correct wire and cable for your particular applications.

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GENERAL ELECTRIC

Notched hand grip, rubber sleeve cutout and pincer jaws mark new safety clamp

these clothespins is a disadvantage in that it often leads to their unfastening as the linemen work, releasing the protecting equipment.

To remedy this, Gordon Solomon, lineman of the Green Bay electric department, Wisconsin Public Service Corp., developed a larger clothespin, approximately 10 in. long, in his home workshop. The opening in this pin is large enough to secure a blanket over a line hose, increasing the safety afforded the utility worker. According to *Contact News*, utility house organ, the device is especially well suited to covering up cutouts and other energized equipment ordinarily difficult to protect.

•

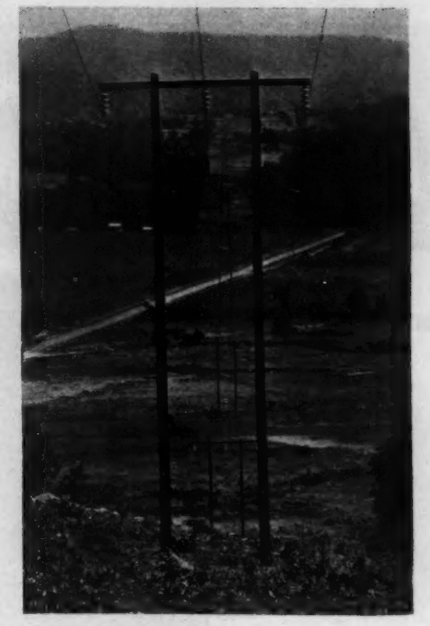
66-Kv. Loop Avoids Capacity Addition

When the need for more capacity to serve the growing load in the area around Fayetteville recently became evident, the Southwestern Gas & Electric Company was faced with the problem either of adding capacity to a small standby plant at Fayetteville or of building a 66-kv. line from Fayetteville to Fort Smith to interconnect with the Oklahoma Gas & Electric Company system.

Construction of the 66-kv. Fayetteville-Fort Smith line was jointly undertaken after a study of the factors involved showed: (1) That both companies would benefit by the expenditure, (2) that this step was more attractive than providing additional generating capacity at either Fort Smith or Fayetteville standby stations, (3) that the Fayetteville-Fort Smith line completed an additional point of interconnection between the system of the Oklahoma Gas & Electric Company and that of the Public Service Company of Oklahoma. The new line provided a two-way feed for Fayetteville and balanced the system supplying Springdale. Accordingly, between January 1 and September 1, 1939, the 66-kv. Fayetteville-Fort Smith line was added, the Springdale-Fayetteville line was changed from 33 kv. to 66 kv. and the steam plant at Fayetteville was eliminated. Arrangement of the system before and after these changes were made is shown below.

First mile of the Fayetteville-Van Buren line consists of single-pole structures upward of 60 ft. in height, spaced approximately 250 ft. apart. This section of the line is provided with an overhead ground wire. The remainder of the line uses two-pole H-frame construction with an average spacing of 550 ft. and storm guyed at 2-mile intervals. The line is designed for heavy loading and is strung for a minimum ground clearance of 18 ft. at this loading. Conductor is No. 2/0 ACSR except on the four long spans, the longest of which is 1,200 ft., where No. 4/0 ACSR is used. Each pole is provided with a ground wire throughout its length which is coiled around the butt of the ground line.

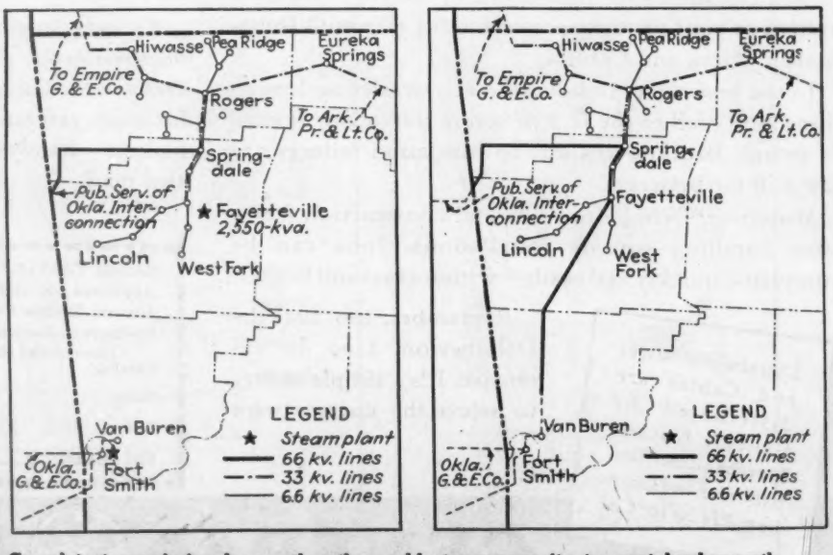
The Fayetteville end of the new 66-kv. line terminates in a new steel substation adjacent to the old 33-kv. substation. The new substation is



Section of 66-kv. line from Fayetteville to Van Buren

equipped with 3,000 kva. in 60/2.3-kv. transformers and the necessary automatic reclosing breakers, directional and overload relays and a synchro-verifier for automatic synchronizing. The present 33-kv. line running north from Fayetteville to Springdale has been reinsulated for 66 kv. and cut through at this voltage to the Springdale substation, where the No. 4/0, 66-kv. line of the Oklahoma Gas & Electric now terminates, thus completing the transmission loop.

The 12-mile line between Springdale and Fayetteville is controlled through motor-operated air-break switches at either end to clear the line in case of fault in that section.



Complete transmission loop rather than add steam capacity to meet load growth
Left—System before completion of loop. Right—After completion.

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Because most electrical, thermal or mechanical insulating jobs require a material with "tailor made" properties it's good business for designers to be well informed on

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This versatile laminated plastic, through laboratory research and close manufacturing control, is adaptable to infinite changes in physical and dielectric characteristics. Its properties can be predetermined to meet your specific needs, thus saving you the trouble and expense of trial-and-error performance tests.

The DILECTO Catalog describes in detail the many grades of this material available in standard forms of sheets, rods, tubes, and parts fabricated to specifications.

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HEADQUARTERS FOR INSULATION RESEARCH

NEWARK-DELAWAR

Every foot of stock sizes of TIREX cords and cables bears not only the name "Simplex-TIREX" but also the size and number of the conductors, their stranding and the voltage the cord or the cable was designed for. Think of what that means to you in convenience and safety. No longer is it necessary to guess that maybe a piece of cable is this size or that. No longer do you need to compromise with safety because TIREX cords or cables tell you for a certainty just exactly what they are. There is no guess work at all.

These new markings are simply an added TIREX feature designed for your convenience and safety and yet they cost you nothing extra. The new markings are molded into the rubber jacket. They are actually a part of the jacket. They are not pasted or stuck on and, therefore, cannot come off. The markings are spaced about every thirty inches.

When you buy cord or cable in the future don't guess – know what you are getting. Specify Simplex-TIREX with the new markings in the "selenium rubber armor." We will be glad to send you a copy of the TIREX catalog with a list of all stock sizes of TIREX. Simply send us a postcard. We will do the rest.

Simplex Wire & Cable Company, 79 Sidney Street, Cambridge, Mass.

Simplex – TIREX

The only cable armored with Selenium Rubber

INDUSTRIAL ENGINEERING

Check Slip-Speed With Neon Device

A portable neon lamp outfit provides a convenient unit for making slip-speed checks in the test department of the Reliance Electric & Engineering Company, Cleveland, Ohio.

Four 115-volt, three-watt, clear neon bulbs are mounted in lamp bases on a small board within a cylindrical steel hood, painted black on the inside to keep out other light rays. On the back of this board is mounted a three-pole, two-way switch. When the switch is thrown in one direction it connects two of the lamps in series, two in parallel, for use on the 220-volt shop circuit. Thrown in the opposite direction, the switch connects all four lamps in series for use on 440 volts.

Slip-speed of a.c. motors operating at less than 100 r.p.m. slip is measured with this device. Directing the light on the end of the motor shaft, the tester counts the number of revolutions per minute of a chalk mark on the shaft-end, marking the time with a stop-watch. Synchronous speed minus slip r.p.m. gives motor r.p.m.

Neon lamp device is adapted to making sharp tests of slip-speed

•

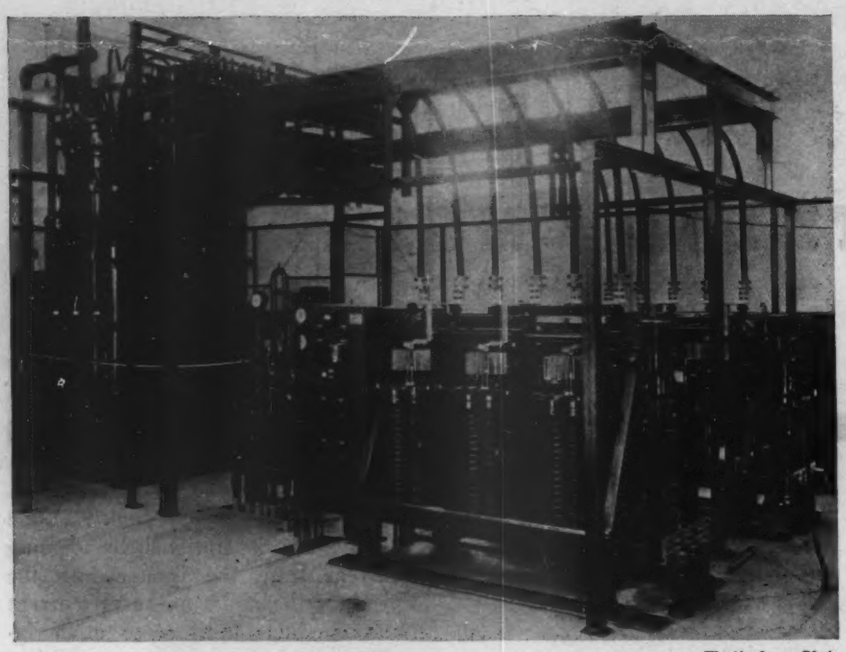
Single-Anode Tank Rectifier Substation

To serve the rapidly fluctuating load requirements an ignitron single-anode tank rectifier, rated at 3,000 kw. and 640 volts, is used as the d.c. supply source at a new automatic substation of the New York Central Railroad.

In contrast with the multi-anode tank rectifier, this rectifier unit consists of two sections of six ignitrons each. Either section may be operated independently and any number of ignitrons may be cut out of service without interfering with the operation of the remaining tubes. Each ignitron consists of a vacuum-steel tube with one anode, one cathode (a mercury pool) and an igniter—a pencil-shaped rod of high resistance that dips into the mercury pool. As soon as the arc is initiated by passing current from the igniter into the mercury the anode picks up current and conducts until some other ignitron anode becomes more positive. At the end of the conducting period the arc goes out in the ignitron. Due to the small size of the individual ignitron tubes, it was found practical to cool the ignitron by wrapping corrosion-resisting copper tubes on it and welding them to the tank side walls, eliminating the need for heat exchangers.

Vacuum auxiliary equipment, consisting of one motor-driven mechanical pump and one mercury-vapor pump, for each group is located at one end of the structure. Control cabinet containing the electrical ignitron auxiliaries, chiefly the igniting tubes and small transformers for lighting the tubes, is mounted on the opposite end. The recirculating water systems, which regulates the quantity of raw water used and maintains the correct operating temperatures for the unit, is located directly back of the two sections.

The rectifier is supplied from one six-phase transformer, rated at 3,340 kva., 13,200/685 volts, 60 cycles, which is fed from Consolidated Edison Company of New York, Inc., lines. Two tanks are supplied from each phase through balance coils mounted on the main transformer. Disconnecting switches are provided to disconnect the individual tanks from the balance coils. Since this transformer is located indoors within the substation, an Inerteen-filled, water-cooled unit was chosen. The interphase transformer is Inerteen-filled and water-cooled; the 37.5-kva. station power transformer is Interteen-filled and air-cooled and the bake-



Westinghouse Photo

Single-anode tank rectifier serves as more efficient d.c. supply source for traction load

Placing one anode in a tank makes for greater compactness, reduces voltage drop and increases efficiency of 3,000-kw., 640-volt rectifier by 1½ per cent over multi-anode-rectifier for 600 volts, or by 2½ per cent over 250-volt type. "Grape arbor" scheme for bringing in leads to anodes facilitates maintenance. Normally, the equipment shown is screened in.

out transformer is oil filled and air cooled. Two control batteries are used in the station. The station control unit is an Exide EM-7 group of 60 cells with a motor-generator charging set and the supervisory control unit is an Exide EM-5 group of 24 coils with a Rectigon charger. Protective equipment for the rectifier includes an automatic oil circuit breaker on the high-tension feed to the main transformer and d.c. reverse power protection through two air circuit breakers to the d.c. bus.

A characteristic of railroad load is that it is extremely fluctuating, so the rectifier is designed to operate at 150 per cent load for one hour and at 300 per cent load—14,063 amp.—for one minute. The rectifier is equipped with a current-limiting regulator that operates practically instantaneously when the load exceeds the overload rating of the rectifier and lowers the output voltage. A Westinghouse "Silverstat" regulator is used for this purpose.

Because of the unique qualities of this rectifier, two new methods for initiating the arc were provided (details in a subsequent issue of ELECTRICAL WORLD).

Completely automatic, the station is controlled by Visicode supervisory-control equipment. Over this supervisory circuit the operator at Grand Central Station (4 miles away) can start or stop the unit, control five outgoing D.C. breakers, and receive an indication of the existence of potential on the high-voltage bus, of the operation of the battery-charging equipment, the operation of any protective device to shut down the unit, differentiating between a temporary shutdown which may not prevent the unit from restarting automatically, and one which locks the station out until the trouble is cleared by an operator and the relays reset manually—as well as whether anyone has unlocked the station door. Remote metering of the a.c. supply current over direct wires is also provided.

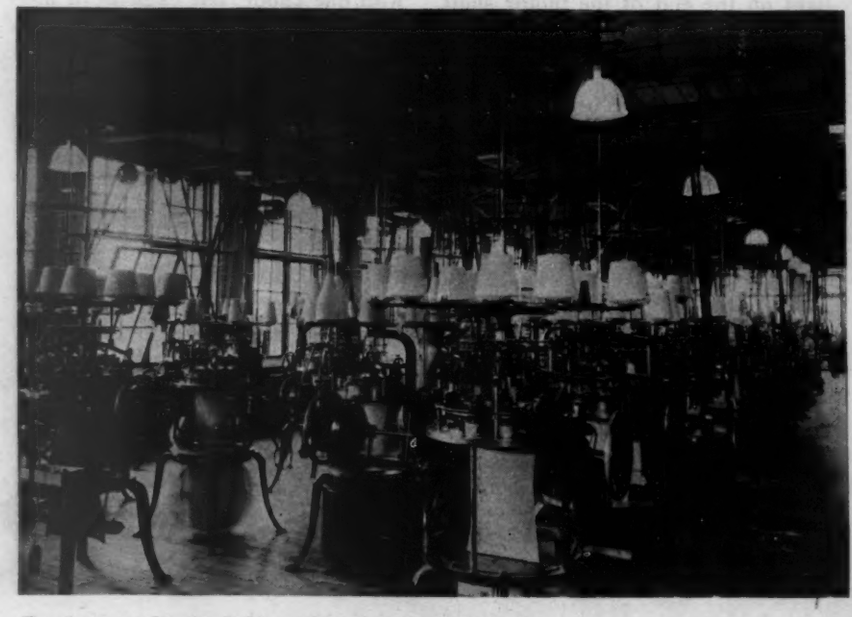
•

Lighting Units Serve Ceiling-to-Floor Space

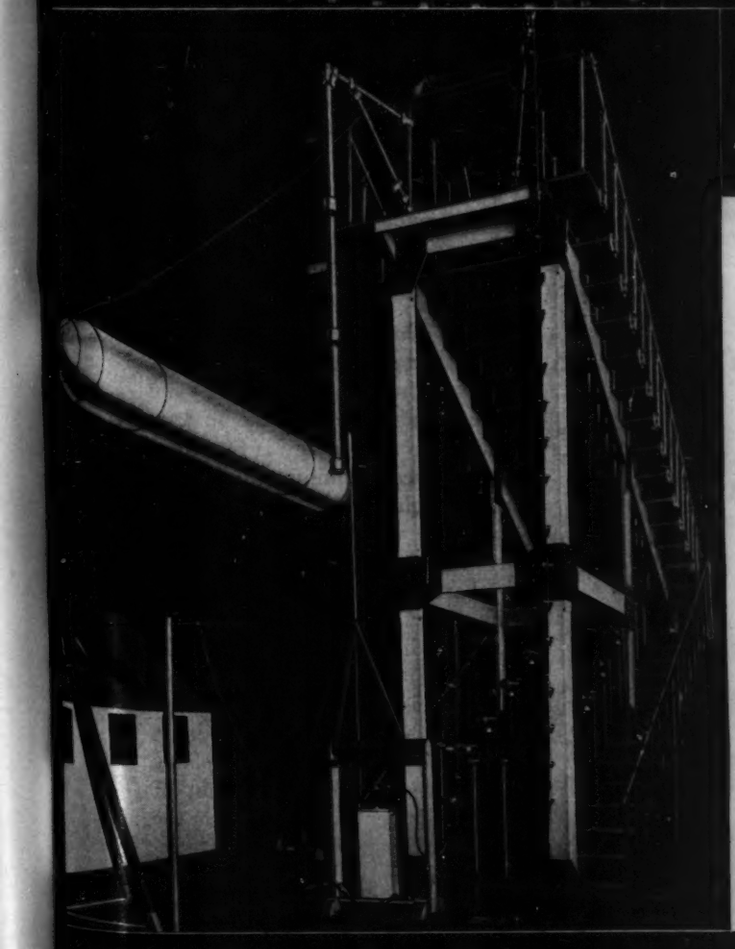
Seventy-two knitting machines with stop-motion equipment located in part on the ceiling and situated in a factory space about 60 ft. long x 25 ft. wide x 12 ft. high presented an interesting lighting problem to the Earnshaw Knitting Company at Newton, Mass., when that organization entered a remodeled plant.

The question of adequate light for maintenance was important, especially in view of the complexity of the machinery, the large number of working parts to be kept in order and the ceiling location of a portion of the equipment. Holophane reflectors housing 100-watt lamps of the inside frosted type and spaced 9 ft. apart longitudinally and laterally, with the lamps 9 ft. above the floor, furnish the desired distribution.

In groups of eight, the machines are driven by nine three-phase induction motors mounted at the ends of the main shafts, one 2-hp. and eight 5-hp. motors being installed. Production can thus be sectionalized as required. No extra lighting is needed for inspection and maintenance of interior machine parts.



Evenly spaced units light machine interiors effectively



Surge Tested.

- The 163,000 volt single phase transformers in the above 48,000 Kva bank were surge tested on the Moloney 2,500,000 volt Surge Generator.

- Having the elaborate equipment necessary for surge testing high voltage power transformers such as these, is only a part of the story.

- The real job is to design and build transformers that will withstand these severe tests.

- Moloney designs and builds high voltage power transformers that not only successfully pass laboratory surge tests, but also provide many years of dependable service in the field.

MOLONEY TRANSFORMERS

NEW ENGINEERING IDEAS

Phototube Method for Bus Protection

By L. D. WHITE
Switchgear Engineering Department,
General Electric Company, Philadelphia, Pa.

Combining speed and reliability under various operating conditions with flexibility and ease of installation, a photo-electric arc detection system has been developed as a practical and inexpensive means of protection for buses for which differential relaying is not feasible. These same features also recommend it as a "back-up" for differential or other types of bus protection.

With this system the entire protected section—buses, circuit breakers, instrument transformers, etc.—is within the range of one or more suitably located phototubes. These tubes are particularly sensitive to the radiations from copper-to-copper and copper-to-steel arcs, but do not respond to incandescent lamp light or to indirect sunlight. They may, therefore, be used in any location where they are not subjected to direct sunlight. The tubes respond readily to arcs of less than 1,000 kva. at distances up to at least 30 ft. from the tube.

Each tube is connected directly to its own small independent amplifier unit. This unit may be placed in any convenient location within a reasonable distance from the tube. Each unit contains a high-speed telephone-type relay, the contacts of which may be used to initiate the desired circuit breaker tripping operations for the protection of the section. A second relay indicates a vacuum tube filament failure by lighting an individual pilot light and sounding a common alarm.

The operating time for such a unit is determined by three elements: The response time of the photo-electric tube, the response time of a vacuum tube and the operating time of the telephone-type relay. The delay introduced by the tubes is negligible, and that of the relay amounts only to a few thousandths of a second. Consequently the unit provides extremely high speed response to any arc within its range. On faults which start within a device the arc detector operation is, of course, delayed until the arc becomes external. For this reason it should not be applied in the place of differential relaying when the latter is feasible. The value of the arc detector system in cases of internal device faults should not, however, be underestimated. The arc detector equipment will operate to isolate the defective apparatus the instant the arc is exposed. Thus it will confine the damage and prevent the more serious results which would unquestionably occur were no form of protection present.

Since each unit is entirely separate and independent, it is not affected by the action, condition or characteristics of any other unit. Consequently, no "matching" of units is necessary.

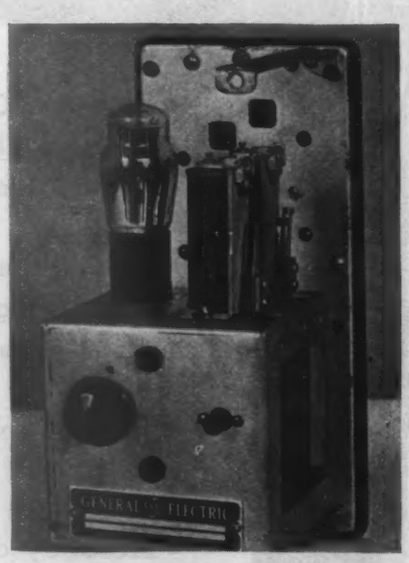


Photo-electric arc detection system developed for bus fault protection

Compact phototube amplifier unit (shown with cover removed) contains telephone-type relay to initiate circuit breaker tripping and relay to indicate vacuum tube filament failure.

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Reflector Surfaces for Infra-Red Lamps

By EUGENE R. D'OLIVE
Testing Department,
Commonwealth Edison Company, Chicago

Tests conducted at the lighting laboratory of Commonwealth Edison on infra-red reflectors lead to these conclusions, disregarding cost figures: (1) Gold-plated reflectors are desirable for applications where they will be free from deposited fumes and dirt and where the ultimate in temperature rise and energy is required; (2) processed aluminum and other more durable finishes constitute a compromise which is sufficiently effective for average to dirty conditions and where extreme temperatures are not necessary; (3) reflector diameter is a factor in determining radiation density; (4) solid angle subtended by reflector is a factor with regard to glare and to percentage of lamp energy redirected to working plane. (With a reflector which has a cut-off below the filament center, glare in the eyes of adjacent operators is prevented to a considerable extent.)

From chart I it might be concluded

CAREFUL SELECTION OF MODERN

GANG SWITCHES

SAVES 15% INSTALLATION COSTS FOR ONE COMPANY...

7500 to 115,000 VOLT - 400, 600, 1200 AMP.

HERE'S something worth investigating. Operating men of a prominent power company found they saved up to 15 per cent in installation costs, over a previous installation, when they specified and used seven 69 KV, 600 ampere Kearney Rotating Insulator Gang Operated Switches.

And these modern switches with exclusive and improved features—sleet-breaking action, multi-point flexing contacts, heavy cross-sections and other features described below are just as reasonably priced as other conventional type switches.

But see for yourself how careful engineering design permits quick, easy and permanent adjustment and easy installation... Ask a Kearney Representative—or write.

KEARNEY FEATURES

POINT PRESSURE CONTACTS

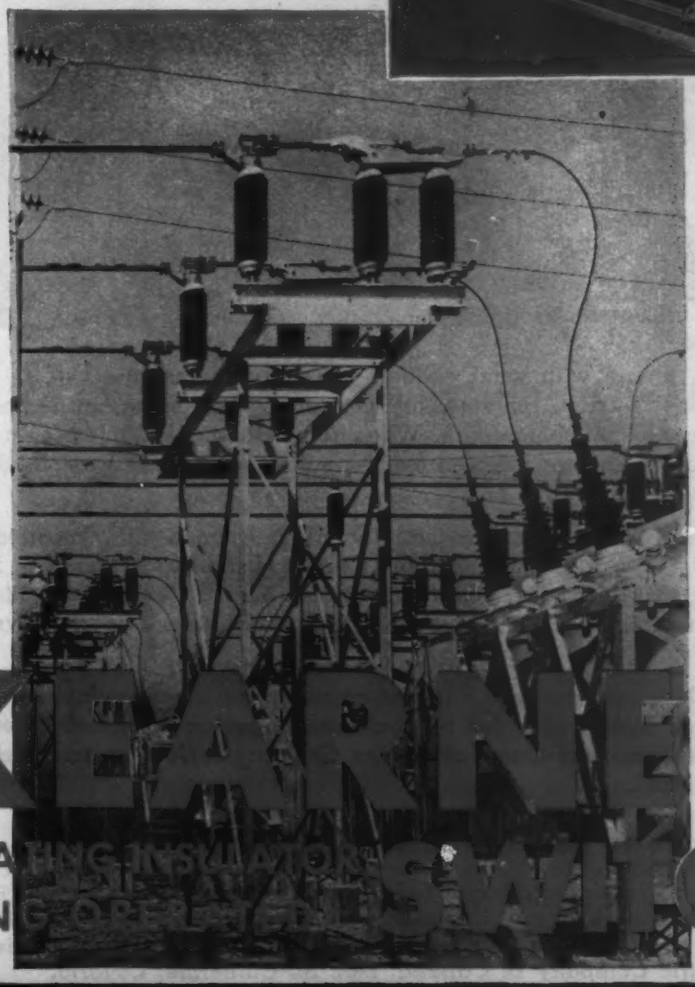
In closing, the blade enters the point pressure contacts without friction, then the toggle linkage expands the blade contacts into full pressure contacts.

AMPLE CARRYING CAPACITY

Current is carried to the blade through point pressure bars, eliminating flexible braids, ribbons and cables. Blade mechanism is past center in full open position.

SAFE OPERATION

The blade operating lever arm is past dead center position and eliminates back pressure on the operating handle in this position.



Use KEARNEY

ROTATING INSULATOR GANG OPERATED SWITCH

MADE BY THE JAMES R. KEARNEY CORPORATION
4224-42 CLAYTON AVE. · ST. LOUIS, MO. · Canadian Office, TORONTO, CANADA

WHEN A FALSE STEP MAY LOOSE AN AVALANCHE

Anyone with wind enough can scramble up the side of an every-day, run-of-the-hill mountain. *Real* mountain climbing —high alpinism—takes something more. When the path at 21,000 feet is a 55 degree ice wall and avalanches threaten every perilous step of the way, it takes experience to reach the summit.

The same principle holds in capacitor manufacturing. Anyone with knowledge enough can assemble a working unit, complete down to the last component. But to seal in surviving soundness . . . resistance to weather . . . exceptional life—the tangibles and intangibles that make the capacitor installation a *paying* investment—that takes experienced engineering.

Cornell-Dubilier with twenty-nine years is first among capacitor manufacturers in experience. And if you're seeking further proof of superior performance and dependability, *witness the fact that there are more C-D capacitors in use today than any other make*.*

There is no substitute for experience.

Investigate how Cornell-Dubilier can put twenty-nine years of capacitor specialization economically to work for you. Complete details on request. Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey. Canadian representative: English Electric Company of Canada, Ltd., St. Catherine, Ontario.

LOOK

at these C-D features

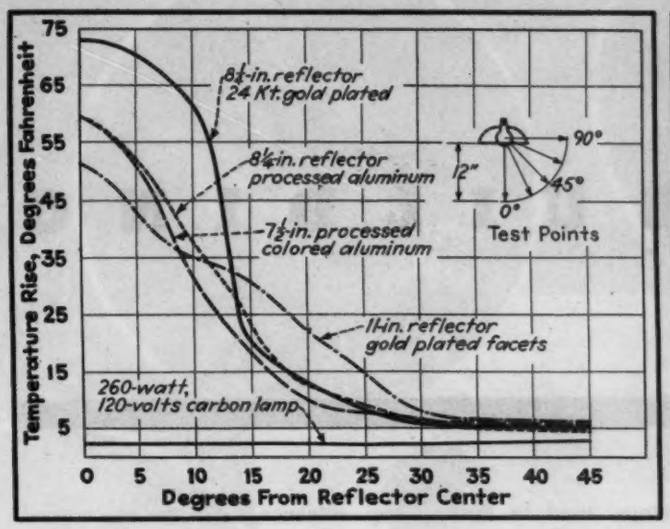
- Impregnated and filled with non-inflammable, non-explosive Dykanol.
- Heavy-duty, three petticoat, fog-type bushings.
- Durable arc welded, leak-proof, copper bearing steel case protected by double coat of weatherproof paint.
- Large number of small capacitor windings, each impressed with a low potential.
- Low loss high quality capacitor tissue used.
- Large factor of safety in design.

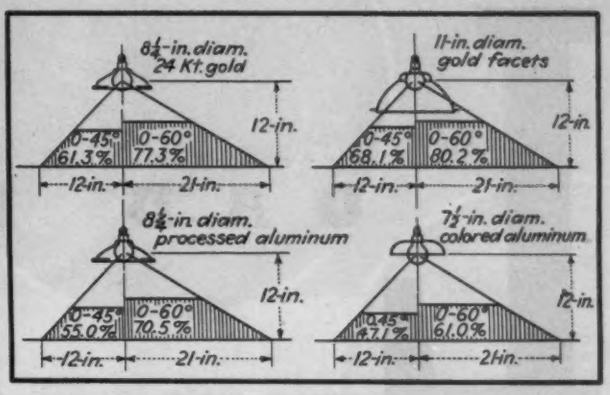
There are more

CORNELL-DUBILIER CAPACITORS

in use today than any other make*

* Including all applications.





Survey by utility shows effect of type of infra-red reflecting surface, angle of cut-off and reflector diameter on temperature rise in per cent of total radiation delivered to the working plane. Left, Chart I. Chart II, right.

that the 8¼-in. and the 11-in. gold-plated reflectors were about on a par, but reference to chart II shows that the total radiant energy delivered on the work by the 11-in. reflector exceeds that given by the 8¼-in. unit. From chart II another point is brought out, namely, that for any given lamp the total radiant energy delivered on the work may be greater for a smaller-diameter reflector even though that reflector as an individual unit has the lower efficiency. Thus, with the 11-in. reflector made up into banks, the spacing ordinarily would be 12 x 12 in. or 144 sq.in. per 260 watts, whereas the 8¼-in. reflector ordinarily would be mounted on 8½ x 8½-in. centers, corresponding to 72 sq.in. per 260 watts.

•

See Electrical Uses for Synthetic Mica

Because it can be produced cheaply in sheets of almost any desired width and length and with varying degrees of flexibility, a new inorganic synthetic product with mica-like and additional electrical characteristics holds interest for electrical manufacturers, in addition to the fact that the raw material for its production is available domestically.

Designated as "Alsifilm" by its developer, Dr. E. A. Hauser of Massachusetts Institute of Technology, in collaboration with Dr. (Miss) D. S. Le Beau, the synthetic product uses Bentonite, a colloidal clay containing aluminum silicate or magnesium silicate, and plentiful in Montana, Wyoming, California and other Western states, as its basic raw material.

A gel of Bentonite and water was found to harden gradually under room temperatures. Spread into thin films and heated, the resultant coherent, self-supporting sheets proved non-inflammable under temperatures ranging to 700 deg. C. and also were resistant to oils and organic solvents. Dry, the film had satisfactory electrical insulation properties, including a breakdown strength of more than 3,000 volts per mil.

When the gel was dried in films by infra red light, using the new General Electric gold-plated reflectors, and treated with appropriate chemicals, for example, lead acetate, the substance took on waterproofness as an added mica-like property.

Today Alsifilm can be produced in films ranging from 0.001 to 0.005 in. in thickness and in practically any width or lengfith—unlike mica. For greater thicknesses, the material can be laminated with or without the addition of synthetic resins or other impregnants. It is translucent rather than transparent, but may be dyed any color while still in the gel state, or mingled with carbon black, which seems to add to its resistance to tearing.

Already one electric motor manufacturer is punching out laminated Alsifilm for commutator segments, insulating rings, etc. Because the material can be made as flexible or as stiff as desired, other manufacturers are considering its possibilities for electric cable insulation, impregnation of textile and glass fiber fabrics. Increasing interest also is shown by the paper and pulp industry, both for electrical insulation and for its resistance to oils, solvents and corrosive chemicals.

•

Filter and Screen Adapt Light Meter

Invisible germ-killing rays produced by Westinghouse's Sterilamp may be measured with this meter. Light from the Sterilamp falls on the dark opaque filter which absorbs practically all of the visible light and transmits at least 50 per cent of the radiations in the 2,537 Angstrom unit region. These radiations, passing through the filter glass, impinge on the white fluorescent screen below and activate the fluorescent coating. Resulting visible light falls on the light-sensitive cell of the foot-candle meter which gives a direct reading. Dr. H. C. Rentschler, director of research for the Westinghouse Lamp Division, calls attention to the component parts of the meter.

Filter and fluorescent screen adapt light meter to ultraviolet measurement

LOAD BUILDING

Fluorescent Lighting Helps Sell Rugs

By ROBERT G. McPHAIL
Worcester County Electric Company,
Worcester, Mass.

By increasing the connected lighting load only from 5,400 watts to 10,450 watts, the average foot-candle intensity in the rug department of the John C. MacInnes Company, Worcester, was raised from 6 to 25. This was accomplished by a strikingly effective remodeling job, in which Hygrade fluorescent lamps were utilized in conjunction with tungsten units to meet the conditions imposed by the architectural layout as designed by Amos Parish. The result is a combination of the warm, cheerful glow of incandescent lighting and the cool brightness of daylight fluorescents without harshness.

The former installation had eighteen 300-watt tungsten lamps in opal inclosing globes. In the remodeled layout five 500-watt and twelve 300-watt tungsten lamps, used in flush boxes with "Contro-Lens"; twenty-two 15-watt and 201 20-watt fluorescents. The intensity on the platforms supporting the rugs above the floor of the display room is 25 ft.-candles, and on open floor spaces and in aisles about 10 ft.-candles. This uneven distribution accentuates the merchandise.

Linoleums are hung in racks, the coloring standing out effectively under the combination of lighting units employed. Here 20-watt fluorescents are mounted both above and below the niches in a continuous strip. The same application is used behind the rug niches. "Daybrite Fluorescent strip" with porcelain "covers" support the lamps. The linoleum rack is done in white and the floor is linoleum, colored yellow marble with black trim. In niches behind the rugs asymmetric "Alzac" reflectors are used, the niches being done in blue. In general the walls are white except for one panel above a broadloom shop entrance, and the depressing effect sometimes found on the ceiling, where flush plate lighting is used, is absent. All the paint is flat and no visible sheen appears, the reflection from walls and other light areas aiding in the distribution effect. Silhouette signs are backed by fluorescent strip lamps in the linoleum shop and elsewhere.

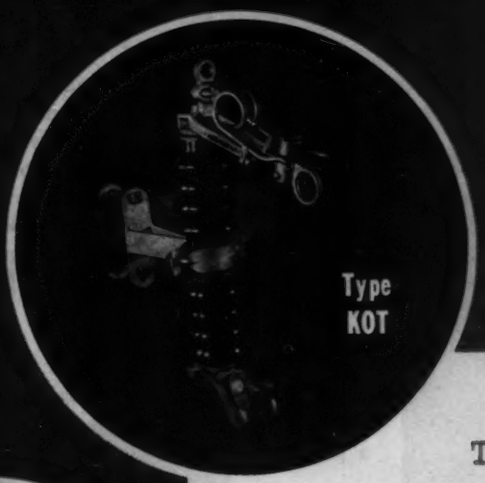
The lighting load is fed by eighteen branch circuits of No. 12 wire. Alternate fluorescent lamps are connected to different phases of the three-phase system serving the department to eliminate any stroboscopic effect, although such an effect would be unimportant in this application even if it occurred.

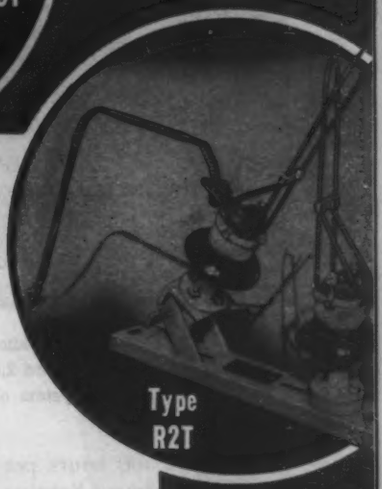
Typical rug niches are 11 ft. wide x 5 ft. 6 in. high, equipped with one 15-watt and five 20-watt fluorescent lamps each. There are two niches 9 ft. wide, each lighted indirectly by three 20-watt and two 15-watt fluorescents.

The estimated annual energy con-

Rug displays in wall niches provided with fluorescent units; rugs on platforms are spotlighted from ceiling fixtures

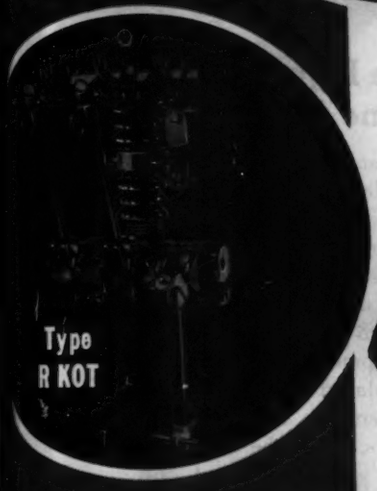
Linoleum display uses both fluorescent strip and ceiling units; total lighting load doubled and intensity quadrupled





To all departments:-

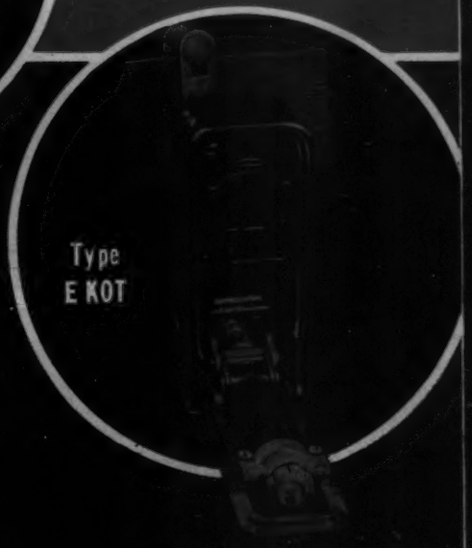
"Specify R&IE equipment in 1940"



R&IE

DISTRIBUTION EQUIPMENT

CONDUCTOR FITTINGS



R & I E pioneered the HI-PRESSURE contact Air-break and disconnect switch - now known as the STANDARD of the INDUSTRY

For your 1940 requirements specify R&IE for RELIABILITY and UNFAILING SERVICE

Build for the years to come

RAILWAY AND INDUSTRIAL ENGINEERING CO.,
GREENSBURG, PA. . . . . In Canada, EASTERN POWER DEVICES Ltd., TORONTO

Shining and spotless, this kitchen "schoolroom" is practically all-electric. Equipment features here are a Griswold 2,600-watt inductance Hotplate, electric warming table and a Peterson ventilating system over the range surfaces

sumption (2,500 hours per year) of the rug department lighting is 26,000 kw.-hr. The installation was sold on the basis of delivering greatly increased intensities with relatively smaller connected load increase, plus the fact that the most modern available lighting co-ordinated with architectural design of high order proves attractive to visitors to a portion of the store somewhat removed from the front of the building.

•

Portland Chefs to Cook Electrically

Restaurant owners in Portland, Ore., by taking part in a vocational training program conducted by Portland School District No. 1, are being sure that they get well-trained personnel. Since ten of Portland's fourteen downtown eating houses are all-electric, with the remainder using electric equipment extensively, their future culinary experts are being given a thorough education in cooking the electric way.

Begun five years ago in the former cafeteria in the Public Service Building, the restaurant training program has been sponsored by the Associated Restaurants of Portland, which acts in an advisory way to Frederick Leasure, director of vocational education. Portland's two electric and a gas utility, manufacturers and distributors of restaurant equipment and culinary unions are co-operating in this effort to electrify restaurant kitchens in Portland.

The electric equipment, which constitutes a majority of the equipment in the kitchen, includes a 200-amp. main service, at 208 volts, three phase. The Griswold 2,600-watt inductance hotplate operates at a most desirable load at 98 per cent power factor, cooking frozen foods at a super speed.

Other equipment are waffle irons, automatic toasters, a steriscald unit, a sandwich toaster, fry kettle, stock pot, electric warming table and two heavy-duty electric ranges. On a separate panel are an electric potato peeler, a large refrigerator, a dishwasher, a 660-watt bun-warming compartment and a Peterson ventilation system over the range surfaces. Beyond the general lighting, there is a 60-amp. lighting panel with continuous rows of lumiline lamps over the range hood and the serving counter, affording a new lighting technique.

A maximum of 38 students are enrolled during the six months course, a period set by the restaurant committee. Various branches of cooking are taught by actual participation in this test restaurant, open to the Portland Public Market.

Type jobs include the dinner cook, fry cook, pantryman, baker, storekeeper, dishwasher. Portland restaurants now require this course as a prerequisite to employment.

•

Triple the Light With Same Load

When fluorescent lighting was first introduced, Henry Weber, retired electrician, had 5 ft.-candles of incandescent illumination in his Chicago delicatessen and liquor store. The combined demand for his home and store was 3 kw. Intrigued with the new development in his previous business he replaced the incandescent lighting with enough fluorescent to give the 5 ft.-candles he formerly had. Pleased with the effect, he doubled the intensity and then tripled it. Now he has 15 ft.-candles and the combined demand of his store and home is still 3 kw., the same as it was with the incandescent.

For general illumination he used six fixtures, each with three 20-watt daylight fluorescent lamps; for the window, eleven lamps, and for the showcases five lamps, making a total of 34 20-watt lamps.

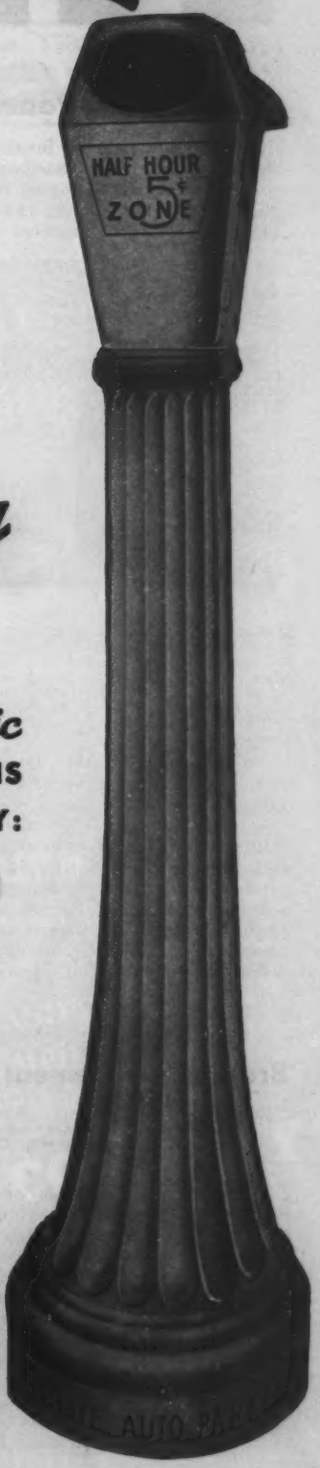
Courtesy of General Electric Company

Retired electrician triples light in his delicatessen with fluorescent, but demand remains the same

NOW!

BLULITE *Electric* PARKING METER

Parking the *Electric way*



● Experience gained in parking meter operation in over 150 municipalities points to BLULITE Electric Parking Meters as the logical choice over inferior or mechanical devices.

For the first time, the difficulties of regulating night parking are overcome successfully. As there is nothing mechanical to get out of order, it requires practically no servicing. Weather does not affect it, there is nothing to rust.

In order to install BLULITE Auto Parkers, highways or pavements do not have to be ripped up.

The trend to parking meters is nation-wide. The BLULITE Electric Auto Parker provides utilities with an opportunity to keep in step with that trend.

Send for full description.

WHAT *Electric* PARKING MEANS TO THE UTILITY:

1. Additional load
2. Installation contracts
3. Maintenance work
4. Community service

ELECTRIC AUTO PARKER CORP.
250 WEST 57th STREET NEW YORK CITY

NEW EQUIPMENT

Oil-Immersed Panelboard

A new thermal-trip breaker has been developed for these panelboards, claimed to produce constant tripping characteristics regardless of temperature changes. A compensating bimetal mounted outside the

Oil-immersed panelboards, using thermal trip branch circuit breakers for lighting circuit protection; permits 0 to 10 per cent decrease in rating when oil temperature is 140 deg. F., 0 to 10 per cent increase in rating when oil temperature is 10 deg. F. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, Pa.

chamber of the breaker frame, in which the main tripping bimetal is inclosed, is affected only by the general temperature of the whole tank of oil. Its motion is transmitted to the tripping bimetal through a link. The base of the tripping bimetal is pivoted, and while its deflection is dependent jointly upon the current and oil temperature, the pivoted base is moved by the compensating bimetal to neutralize the deflection due to the oil temperature.

•

Bracket Attachment

"Simplex" arm attachment; consists of a pole plate face and simplex shoe; for street-lighting bracket. **Union Metal Mfg. Co.**, Canton, Ohio.

The pole plate face is one size and shape, permitting interchanging of various brackets. The lip of the plate is shaped to serve as a guide. This is said to provide ample space to bring the feed wires out of the pole into the bracket arm without making a sharp bend. The shoe is welded to the bracket pipe arm. The countersunk hole near the bottom engages the tapped hole in the pole plate, which is slightly lower than the hole in the shoe, so that the shoulder of the screw first bears on the lower edge of the countersunk hole, which tends to pull the shoe downward. This is claimed to hold the bracket pipe arm in a positive rigid position.

•

Battery Unit

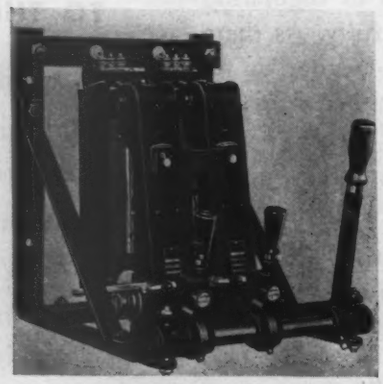
"Connectapower," a battery replacement unit for private telephone and signal systems; for 110 or 220 volts, a.c. **Connecticut Telephone & Electric Corp.**, Meriden, Conn.

This unit plugs into the lighting circuit and provides power output for the talking and ringing circuits for telephones, bells, annunciators, etc. It is made in several sizes to meet requirements for both large and small systems.

•

Lamp Dimmer

This dimmer has the characteristics of an auto-transformer with an infinite number of steps and its low losses result in a minimum amount of heat dissipation. The company claims that it will control any load from a 10-watt lamp up to the maximum rating of the dimmer with equal facility and the same rate of change in intensity. At any dimmer position the connected load may be increased or decreased without affecting the intensity.



"Autrastat Dimmer," for controlling lamp brilliancy; available in 4,000, 5,000 and 6,000 watts maximum capacity for use on 110-120 volt, 50-60 cycles, a.c. **Ward Leonard Electric Co.**, Mount Vernon, N. Y.

For names, addresses and products of electrical manufacturers, see "Electrical World" *Electrical Buyers Reference* first.

Parking Meter

The entire operation of this meter consists of lighting an intensive blue light by the insertion of a coin in a slot at the side of the machine. The light will remain lit for the time prescribed by city ordinance, either fifteen minutes, 30 minutes, 45 minutes, one hour, or any other desired period. When the time has expired the light goes out. The meter may be connected with the city lighting system or metered separately. Installation is accomplished by a specially designed machine which bores under the sidewalk.

"Blulite" auto parker; contains two 7½-watt lamps connected in series. **Electric Auto Parker Corp.**, New York, N. Y.

•

Planer Drive

Variable-voltage drive for reversing planers; available in speed ranges from 40 r.p.m. to 1,200 r.p.m. **General Electric Co.**, Schenectady, N. Y.

The drive itself consists of four pieces of rotating equipment—a planer drive, a d.c. generator, an a.c. drive motor and an exciter. The control system consists of an inclosed control panel, a speed-regulating rheostat, a planer limit switch, a pendant push-button station and a starter for the motor-generator set. The company claims that this drive offers the advantages of wide speed range, extremely fast acceleration and deceleration, high-cutting efficiency, accuracy in stopping and a very simple control system.

•

Fluorescent Fixture

"Flur-o-liter;" twin lamp fluorescent fixture for 40-watt lamps. **Benjamin Electric Mfg. Co.**, Des Plaines, Ill.

Unit is designed to provide about 100 ft.-candles over machines, inspection benches and production lines. These units

PEIRCE NO.1358 RACKS

HAVE WADED THROUGH

COUNTLESS HAZARDS FOR MANY DECADES—AS ORIGINALLY DESIGNED—STILL PROVIDING THE ULTIMATE IN SERVICE AND THE MINIMUM IN MAINTENANCE—TRIUMPHANT IN THE FACE OF COUNTLESS IMITATIONS.

HUBBARD AND COMPANY

PITTSBURGH · OAKLAND · CALIFORNIA · CHICAGO

"HANG THE LOAD ON HUBBARD HARDWARE"

In One Convenient Package—

ALWAYS A SELLOUT—
RESERVE YOUR COPY NOW!

The Industry's Figures and What They Mean. Since 1904 Electrical World has been presenting and interpreting electric utility facts and figures; 1939 has been a pretty important year in the industry. Just how important is not fully realized until you see the figures, look at the record—and compare 1939 with previous years.

• In this one convenient package the January 13 issue of Electrical World gives you a clear-cut, accurate picture of just where the electrical industry stands today and what may be expected of it during the year ahead. • Complete presentations of nation-wide phases of power company operation and management make this one number the most looked-for, looked-at, looked-up periodical in your field. Use the handy coupon and mail your reservation today.

In addition to the customary data, the 36th Annual Statistical Number includes

TWO NEW EXTRA FEATURES

Output Curve from 1902-1940 — One of the most widely used features in Electrical World is the weekly output curve, index of the electric utility industry.

We believe that a chart that would show the trend of the output curve from way back would not only be interesting but valuable to manufacturers and electrical engineers as well as utility men. So in your copy of the January 13 issue there will be included, as a supplement, the graph of electricity output for 1902-1940.

To make it more useful for reference purposes, this pull-out folder chart will be large enough to slip under the glass top of your desk or hang on the wall. Space for 1940 will be left so you can add to the curve the weekly output figures as they are reported in Electrical World. Other small graphs on the sheet will include such information as Residential, Commercial, Industrial energy consumption.

Two Decades in Electric Utility Industry — At the end of a decade, it is interesting to see what changes have taken place in life about us. In the utility industry it is interesting not only to note the changes that have occurred in the past ten years but also to compare 1929-39 with 1919-29.

The 20's saw the most rapid growth of the electrical industry. By contrast, it is generally thought that the electric utility industry made small progress in the 30's. This idea is often brought out as a criticism of the industry's initiative. But this idea is not correct, nor even largely so... as will be demonstrated in two pages of graphic data in the 36th Annual Statistical Number, January 13 issue.

. . . A quick picture of where the ELECTRICAL INDUSTRY stands today—and what may be expected of it in *1940*

EVERY ELECTRICAL MAN regardless of the position he holds, will want a personal copy of this most widely-used and consulted issue of the year... because it contains "all the answers."

The "answers" will affect every man in the electrical industry. Only by reading, first-hand, your industry's leading technical and news publication—Electrical World—can you hope to keep fully informed on these vital subjects and know about their influence on your own work and rewards.

If Your Interest is in ENGINEERING & OPERATING you will find in this issue up-to-the-minute figures on—

energy output . . . generating capacity . . . new stations, completed and scheduled . . . fuel consumption—average hours of use, plant loading, capacity factor—and other station operations.

If Your Interest is in COMMERCIAL LOAD-BUILDING you will welcome the facts and figures on—

energy sales by classes of customers . . . average revenue per kw. by classes . . . national, state and sectional breakdown of customers . . . REA activities and rural developments.

If Your Interest is FINANCIAL you will certainly want the accurate year-end figures on—

operating expenses, including maintenance and wages . . . operating ratios . . . increases in taxes . . . amounts and terms of security issues, bonds maturing, etc. . . . the 1940 prospective capital expenditures in terms of prime mover, transmission, distribution and miscellaneous, with the total investment by type of property.

In short, the January 13 issue—36th ANNUAL STATISTICAL NUMBER—will give you much more than just figures. It will present vividly to every electrical man a dramatic, timely picture of the opportunity for developing the electric power industry in 1940.

With essential facts and figures, interspersed with concise interpretations, the 36th STATISTICAL NUMBER of Electrical World shows—

- ★ What additions were made to Power Plant Capacity during the year.
- ★ What Additional Capacity is planned for '40 and '41.
- ★ What the total Generating Capacity was for '39.
- ★ How rapidly Domestic Consumption is rising.
- ★ What the total Capacity is in each state—Steam, Hydro, etc.
- ★ How much average Rates Decreased. (Industrial, Residential & Commercial).
- ★ How many New Customers in each state (by classes).
- ★ What the prospects are for New Substation Capacity.
- ★ How fast Rural Service is being extended.
- ★ What part of Earnings goes into Operating Expenses.
- ★ What part of Earnings goes into Wages . . . Taxes.
- ★ How much New Capital was Invested . . . How much for Refunding.
- ★ How much Money the Utility Industry will spend for New Construction in 1940.

RESERVE YOUR COPY NOW FILL IN and MAIL TODAY

ELECTRICAL WORLD, 3000 McGraw-Hill Bldg., New York, N. Y.

(If you are already a subscriber to Electrical World, you will automatically receive the January 13, 1940 Statistical Issue without extra cost. But if you want extra copies, we suggest you make your reservation now. Use the handy coupon!)

★ Please reserve.....copies at $1.00 each, postpaid, of the 36th Annual Statistical Number of Electrical World . . . including the Chart Supplement showing OUTPUT CURVE from 1902-1940. Please send my copies and bill to me at the address indicated in this coupon.

★ Please enter my subscription to Electrical World for one year, with the understanding that the January 13 Statistical Number (and OUTPUT CURVE from 1902-1940) will be included without extra cost to me. Please bill me for 52 issues at $5.00—(annual subscription price U.S.A.)

My name ..... *Title*.....

Company .....

Address .....

City and State 12-30-39

modernize
YOUR
DISTRIBUTION
PRACTICE—

Rural line transformer pole with a secondary span to a yard pole.

RELIABLE
SOLDERLESS
CONNECTORS

Split bolt connectors have become standard in the industry. Reliable Electric offers well designed types for all applications. Shown above are aluminum to copper connectors which provide adequate spacing between the red and white wires to avoid galvanic corrosion.

Reliable
ELECTRIC COMPANY
OVER 25 YEARS SERVICE TO THE UTILITIES

incorporate under one housing individual reflectors for each lamp, sockets complete with thermal glow-switch starters and line ballast equipment for regulating current to the lamps. They are equipped with the "Tulamp" type ballasts. Intensities can be maintained uniformly along the line when units are spaced as much as 40 in. between adjacent ends, the company claims.

•

Pin-Type Insulators

An underglaze is applied to the conductor groove, the tie wire groove, the pin hole and the joints (of multiparts). After the conducting glaze is applied the insulator

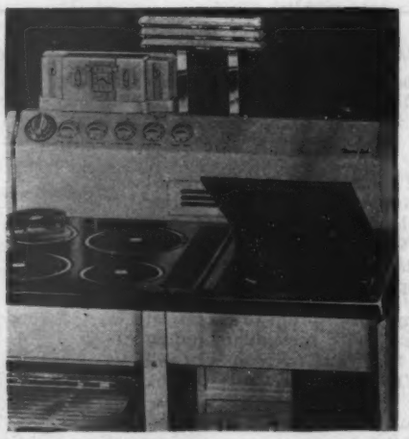
"Conduction-glazed Silentype" insulator, supplementing the line of metallized Silentypes; includes all sizes of high-voltage pin types, both multiparts and uniparts; also low-voltage pin types. **Ohio Brass Co.**, Mansfield, Ohio.

is coated with the regular outer glaze and then fired. The conducting element in the underglaze comes through the outer glaze during firing and is claimed to make a good bond with the tie wire and conductor. The manufacturer claims that the new conduction glaze results in a high degree of uniformity, provides a treatment which is permanent electrically and mechanically, prevents conductor abrasion by providing a smooth finish and permits use of time-tested standard pin-type designs.

•

Electric Range

The new feature of this range is the coal side cooking top, which may be fired



Huron circulating heater electric range, a double-purpose unit. **Round Oak Co.**, Dowagiac, Mich.

at any time; either electric, coal and wood may be used alone or together. It may be used to burn refuse and as a circulating heater. Vertical porcelain flues receive cold air from openings in the rear of the cabinet base at floor level and from a slot opening in the front of the cabinet base. This air gains heat from the fire box and rises to the room through grills on each side of the coal side cooking top. In the electric section the four surface units may be lifted for cleaning purposes.

•

Melting Kettle

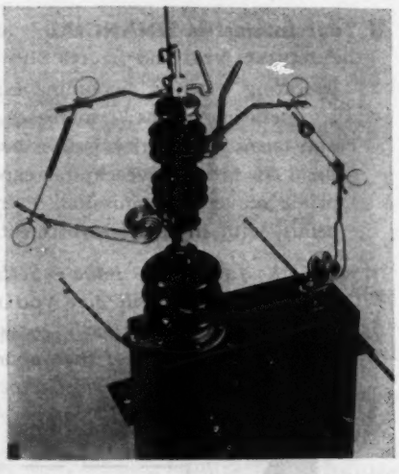
"Marine glue kettle;" for temperatures from 80 deg. to 550 deg. F., in sizes from 5 to 50 gallons. **Acme Electric Heating Co.**, Boston, Mass.

A multiple heating element surrounds the entire cylindrical area of the kettle. A similar element is used for the underside of the kettle. A protector guard prevents injury to the thermostat bulb that is submerged within the kettle. This kettle may be used for any mastics or plastics up to 600 deg. F.

•

Capacitor Protective Unit

This unit makes it possible automatically to short and discharge a condenser when the fuse protecting that condenser blows and removes the capacitance from the circuit. When the fuse parts the spring-actuated lower contact of the "Trip-O-Link," which is rigidly mounted on the top of the condenser bushing, moves down-



Capacitor protective unit; an application of a "Trip-O-Link" fuse switch to a capacitor. **James R. Kearney Corp.**, St. Louis, Mo.

ward to engage a set of auxiliary, grounded contacts, and thereby shorts and discharges the condenser. A "Trip-O-Gap" protects the condenser from lightning surges and other harmful surge voltages.

•

Distribution Transformer

Primary pocket stud-bushing type "HEX" transformer, 1½ to 10 kva. (core type), 15 to 100 kva. (shell type)—up to 5,000 volts. **Wagner Electric Corp.**, St. Louis, Mo.

This transformer is equipped with pocket stud bushings on the high-voltage side and tank wall stud bushings on the low-voltage side. Solderless connectors are set within the bushing so that a portion of

the bushing covers the bared end of the connecting lead, which, it is stated, provides added safety to the linemen.

•

TECHNICAL LITERATURE

BUILDING WIRE—Report on investigation of small diameter building wire gives the description of equipment and preparation of test samples, procedure, discussion of results and observations, conclusions and recommendations, and a section of tables and charts. Copies may be obtained from National Electrical Manufacturers Association, 155 East 44th Street, New York City.

SYNCHRONOUS MOTORS—Operating characteristics, economies and applications of the synchronous motor are discussed in publication GEA-1191B of the General Electric Co., Schenectady, N. Y. Two charts in the booklet should also be convenient; one indicates synchronous motor ratings and the other is a direct-reading power-factor-improvement chart.

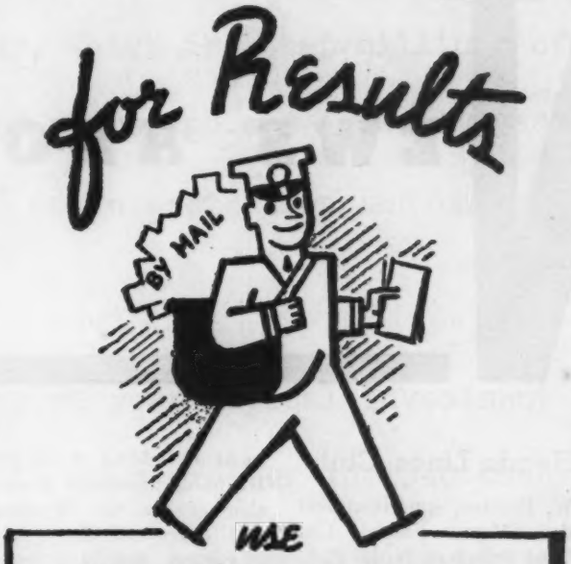
METAL ANALYSIS—Metallic materials for electrical heating are included among those for which analytical procedures are listed in the second edition of "A.S.T.M. Methods of Chemical Analysis of Metals." A compilation of the latest approved standards, the book includes four standards for ferrous metals, twelve for non-ferrous metals and alloys and three for spectrochemical analyses. Copies may be obtained from American Society for Testing Materials headquarters, 260 South Broad St., Philadelphia, Pa., at $2 per copy in paper cover, $2.50 in blue cloth binding.

TEXTILE STANDARDS—Included in the 1939 "A.S.T.M. Standards on Textile Materials" are three on asbestos roving, yarns and tape for electrical purposes and one on tentative methods for testing thickness of solid electrical insulation. Copies of this year's 320-page compilation of specifications, tolerances, methods of testing and definition of terms may be had from A.S.T.M. headquarters, 260 South Broad St., Philadelphia, Pa., at $2 each.

ALLOY CHART—Listed on this 25x30-in. wall chart are the chemical analyses, physical properties and recommendations for use for non-ferrous and cast iron alloys included for such standards as A.S.T.M., Navy, etc. Also data for the analysis, application, minimum physical properties and creep strength for Chapman cast steels. May be obtained from the Chapman Valve Mfg. Co., Indian Orchard, Mass.

STERILAMP USES—Applications and advantages of the Sterilamp in various food industries are described and the Rentschler-James process of sanitization through ultra-violet radiation is discussed in a new bulletin (A-2793) published by the lamp division of Westinghouse Electric & Mfg. Co., Bloomfield, N. J.

CABLE INSULATION—"Simplex-Anhydrex AA Deproteinized Rubber Insulation," published by Simplex Wire & Cable Co., 79 Sidney St., Cambridge, Mass., considers the development of this type of rubber insulation for wires and cables. History of development is traced and electrical and physical behaviour of underground and submarine cables using this type of insulation are charted and discussed. Appendix lists other types of tests carried out on insulation.



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NEWS ABOUT PEOPLE

Proctor Heads Lines Club

Kenneth W. Proctor, superintendent of the Malden (Mass.) Electric Co., has been elected president of the Electric Lines Club for 1940 and 1941. Fred W. Hubbard, electrical engineer New Bedford Gas & Edison Light Co., has been made vice-president, secretary and treasurer of the organization, which is an active group of New England utility operating men meeting several times annually to discuss current problems in transmission and distribution engineering.

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▶R. S. TAYLOR, formerly division engineer, Oklahoma Gas & Electric Co., Muskogee, is now with the district engineering department of the company at Oklahoma City.

▶R. C. ADAMS, chief engineer of the Fremont, Neb., municipal power plant for several years, has been named general superintendent of the new municipal power plant at Provo, Utah.

▶A. S. ANDERSON, formerly assistant superintendent of distribution, New Orleans Public Service, Inc., New Orleans, La., is now connected with Ebasco Services, Inc., New York, N. Y.

▶THOMAS W. MARTIN, Alabama Power Co. president, has been chosen by the French government for the Palmes Academiques decoration in recognition of his work as a historian in compiling a book on French colonization and for his research and lectures on French colonists in Alabama. The announcement was made by Consul-General Rene Soulange-Teissier of New Orleans.

▶C. J. HOLSLAG, president, general manager and chief engineer, Electric Arc Cutting & Welding Co., Newark, N. J., has been awarded the Samuel Wylie Miller Memorial Medal of the American Welding Society. He was selected as the "most deserving for conspicuous contributions to the advancement of welding or cutting of metals." He holds numerous patents, is the author of the Arc Welding Handbook and other contributions to technical literature, and is a member of the American Institute of Electrical Engineers, American Welding Society and the American Electrochemical Society.

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Derry Named Manager New Industries Dept.

H. W. Derry, for the past three years principal industrial engineer for the Tennessee Valley Authority, has been engaged by Pacific Power & Light Co., Portland, Ore., to help in the general effort to secure new employment-giving industries to utilize the natural resources of the Columbia Basin.

Obtaining his early experience with

the Westinghouse Electric & Manufacturing Co., Mr. Derry got into the sales end of industrial power. He became identified with the Pittsfield (Mass.) Electric Co. as contract manager in 1913, and then with the Hartford Electric Light Co. as industrial engineer from 1918–1924. By this time he had gained a broad background in textile, paper, tool steel and other industries. From 1924–28 he was sales manager of the electric division of Union Gas & Electric Co., Cincinnati. Mr. Derry was appointed industrial sales manager of the Pennsylvania Power & Light Co. in 1928. His work with industrial plants included steel, cement, coal and textiles. In 1935-36 he served as consultant on exhibits for the Third World Power Conference, Washington, D. C. In 1936 he joined TVA.

Because of the availability of large blocks of power from the federal projects on the Columbia, his experience and acquaintance in the heavy industry field is expected to be of particular value in his new position of manager of the new industries department.

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▶EDMUND W. WAKELEE, president of the Public Service Corp. of New Jersey, has been elected chairman of the board of the Palisades Trust & Guaranty Co. of Englewood.

▶C. E. WEBB has been elected chairman of the Vancouver branch, Engineering Institute of Canada, succeeding Ernest Smith.

▶ROY A. PALMER, illuminating engineer, Duke Power Co., has been elected to the presidency of the Charlotte Engineers Club.

▶J. C. ADAMS, former assistant to the engineering manager G.E. Co., Bridgeport, Conn., and before that designing engineer for the Edison Electric Appliance Co., Chicago, has been appointed chief engineer of Manning, Bowman & Co., Meriden, Conn.

▶S. H. HAZLETON, JR., has been appointed illuminating engineer for the incandescent lamp department, General Electric Co., San Francisco division. Mr. Hazleton is to fill the vacancy made by the death of the late Leo Gianini. A native of Iowa, Mr. Hazleton is a University of Michigan graduate. Following graduation, he took the G.E. test course at Gary, Ind., and

there is only one reason why you will be interested in the fact that 1940 will be our 47th year, which is, that millions of feet of ORANGEBURG installed over 40 years ago are in active service today and still affording 100% cable protection and underground raceway facilities.

The long-term security of your capital investment in underground distribution will be much greater in 1940 than at the turn of the century as ORANGEBURG has kept pace with the progress of your industry.

We are sincerely appreciative of your confidence in the past. 1940 will, we believe, afford both of us opportunities to demonstrate that our common heritages are worthy of our utmost efforts to maintain and surpass achievements of which we have reasons to be proud.

THE FIBRE CONDUIT COMPANY

Fred P. Combier

Frederick P. Combier
Vice President
and
Sales Manager

Sales Agent - Distributors

Graybar Electric Company, Inc.
General Electric Supply Corp.

later went to the Schenectady works, then to Nela Park at Cleveland. Then he served as assistant illuminating engineer in the Philadelphia district. He will specialize in illuminating engineering consulting work for the lamp department in northern California and Nevada.

▶O. L. WORDEN, formerly valuation engineer, New York State Electric & Gas Co., Ithaca, N. Y., has joined the Crouse-Hinds Co., Syracuse, N. Y.

▶JOHN BRAY, credit manager Graybar Electric Co., San Francisco office, plans to retire in 1940 after a business lifetime spent with Graybar and its predecessor, Western Electric Co. He was first connected with the electrical industry in San Francisco as a member of the pioneer California Electric Works. He will be succeeded by JOSEPH M. CROTTY, formerly assistant credit manager, Chicago.

▶F. SCHAAF, who recently resigned as Washington State Public Service Director, will be chief counsel for the Puget Sound Power & Light Co. in the Public Utility District condemnation suits brought against the company in six Washington counties. His headquarters will be in Seattle. Mr. Schaaf, who has been with the Public Service Commission for a number of years, has established a general law practice, specializing in all types of public service company cases.

▶GEORGE J. TAYLOR, formerly commercial engineer for G. E. Vapor Lamp Co., Hoboken, N. J., until its recent merger with the incandescent lamp division to form the G. E. Lamp department, has been transferred to the Nela Park engineering department, Cleveland. In his new work Mr. Taylor heads up industrial lighting activities, giving special attention to practical application of lamps to illumination of factory areas.

▶J. A. FRENCH has been appointed chief engineer of the Guardian Manufacturing & Supply Corp., New York. Mr. French was formerly identified with the public utility industry. He joined the Eastern Connecticut Power Co. in 1919 as construction superintendent, becoming electrical engineer in 1921. When the company became the eastern division of the Connecticut Power & Light Co., in 1928, he became research engineer for the eastern division, continuing in that position until 1938. He was electrical engineer in the consulting division of Day & Zimmermann, Philadelphia, until his present appointment. Mr. French is a past-chairman of the A.I.E.E. Connecticut section.

T. Fort Will Assume New Duties in Pittsburgh

Tomlinson Fort has been appointed assistant manager of central station sales by the Westinghouse Electric & Manufacturing Co. He will assume his new duties on January 1 and will be located at East Pittsburgh. Mr. Fort was formerly in the company's New York office, where he has been in the central station division since 1931.

Mr. Fort became identified with Westinghouse in 1923 immediately upon his graduation from the New

Mexico College of Agriculture and Mechanic Arts. Upon completion of the Westinghouse student course he entered the power department at East Pittsburgh, later being transferred to Sharon, where he worked in the power transformer sales section until 1927. Subsequently he joined the Albany staff and then removed to New York to handle part of the central station sales work of the company in the metropolitan area. He has represented the Westinghouse company in many large negotiations during the past eight years. Mr. Fort has been active in various engineering societies and is the joint author of two articles published in the ELECTRICAL WORLD in recent years and the contributor of articles to other technical papers.

▶KENNETH C. GIFFORD will assume the duties of general sales manager for the Schick Dry Shaver, Inc., on January 1. Mr. Gifford resigned on December 1 as general sales manager of the Toastmaster products division of the McGraw Electric Co., Elgin, Ill. Mr. Gifford's long experience in the specialty appliance field fits him well for his new executive duties. He takes the place of Stanley Nowak, who has resigned, effective December 15. Mr. Gifford became connected with the McGraw Electric Co. and Toastmaster products in 1927. Prior to joining the McGraw organization he was sales manager of the domestic department of the Waters Genter Co., Minneapolis, Minn. In addition to his duties as general sales manager of Schick at headquarters in Stamford, Conn., Mr. Gifford will have complete supervision over the field sales force.

▶R. B. CAPRON has been made distribution engineer for the Central New York Power Corp., with headquarters at Watertown, N. Y. He was formerly district engineer at Potsdam.

▶WILLIAM G. KING, Salt Lake City, is now located in Portland, where he has assumed managership of the Electrical Products Corp. of Oregon, maker of Neon signs. He succeeds W. S. CHRISTINE, who has resigned to move to Los Angeles.

▶G. A. PALKA, formerly junior engineer, Federal Emergency Administration of Public Works, Chicago, Ill., is now connected with the Standard Transformer Co., Warren, Ohio, as designing engineer.

▶D. S. RICHARD, dealer sales manager of the Birmingham Electric Co., Birmingham, Ala., has been appointed residential sales manager to succeed Barney DeRamus, who has recently become associated with the Steel City Appliance Co., Alabama distributors for Crosley products.

OBITUARY

▶L. F. JOHNSON, district manager for the Iowa Public Service Co. at Cherokee for the past eight years, died at his home in that city December 5, of a heart attack.

▶DR. STANLEY S. SEYFERT, head of the department of electrical engineering at Lehigh University, Bethlehem, Pa., died on December 13, in his fifty-ninth year. Dr. Seyfert received his engineering education at Lehigh and had been connected with the teaching staff since 1904. He was the inventor of a single-phase commutator motor. He was a member of the American Institute of Electrical Engineers, the Electrochemical Society and the Society for the Promotion of Engineering Education.

▶MAJOR MICHAEL F. OWENS, widely known in the electrical industry for his 30 years' general managership of the Automatic Refrigerating Co., Hartford, Conn., died at his home in that city December 10. He was born in Hartford in 1875 and in his early career was commercial manager of the Hartford Electric Light Co. At one time he was an instructor at the Massachusetts Institute of Technology.

MANUFACTURING - MARKETS

Westinghouse Shows Sharp Rise in Net

Adjusted compensation of 10 per cent will be paid to all employees of Westinghouse Electric & Manufacturing Co. this month, in accordance with the wage and salary plan. This compares with a 6 per cent bonus paid in November.

Net earnings for the last three months totaled $4,290,094, of which $1,104,137 was earned in September, $1,363,840 in October and $1,822,117 in November. With the addition of November's earnings, total profit for the year to date rose to $12,255,765. In all of 1938 Westinghouse had net profit of $9,052,773.

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Copperweld Issues Stock; Makes Offering of Bonds

Public offering has been made of 10,000 shares of 5 per cent cumulative convertible preferred stock of the Copperweld Steel Co. The stock was priced at $50.50 a share. Net proceeds will be used in part to redeem certificates of indebtedness due in 1946 and 1947, of which $198,768 was outstanding on October 31. The remainder of the proceeds will be used to repay part of a $500,000 bank loan.

The company has completed the sale of a new issue of $2,000,000 of 4½ per cent first mortgage 15-year bonds to the Metropolitan Life Insurance Co.

•

N.A.M. Law Digest Gives Analysis of Contracts

An analysis of the principles and procedures relating to contracts between government and private business, believed to be the first complete study of this important subject, is contained in the combined November-December issue of the National Association of Manufacturers' Law Digest, just released to the membership of the association.

It is pointed out that the necessity for understanding federal requirements in the matter of contracts is not only increased by the peacetime needs of national defense but also because of a "growing tendency in recent years to extend such requirements by statute or interpretation to manufacturers and suppliers having no direct contractual relationship with the government."

•

Philco Plans Convention

Philco Radio & Television Corp.'s convention, featuring its new line of Philco refrigerators and air-conditioning equipment, will be held in Palm Beach, Fla., for four days beginning on January 15. All features of the convention will be repeated for the benefit of distributors and dealers west of the Rocky Mountains on January 23, 24 and 25 at a special west coast and mountain convention in the Hotel Del Coronado, Coronado Beach, Calif.

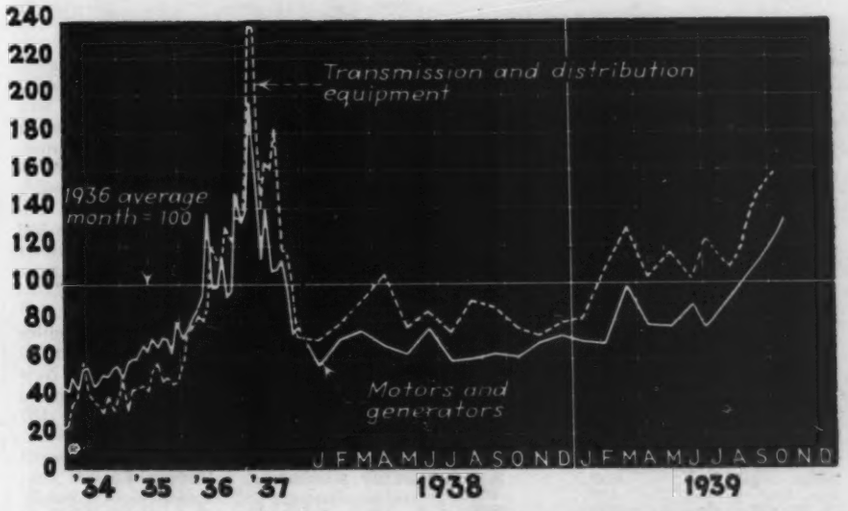
Equipment Orders Continue to Gain

In a contra-seasonal gain, the NEMA index of orders received for motors and generators during October rose to 136.5, a rise of 20.1 points, or of 17.3 per cent from the revised September index and of approximately 124 per cent over October of last year. The gain for October over September compared with a decrease of 2.7 per cent last year and with a decrease of 14.1 per cent in 1937. The new October figure is also an all-time October high, as well as the highest mark the index has reached since June, 1937.

Average of the index series for mo-

Month	Motors and Generators		Transmission and Distribution	
	1939	1938	1939	1938
January	69.2	57.4	81.0	70.2
February	67.8	70.8	108.3	79.3
March	99.3	74.7	129.1	91.4
April	77.5	66.6	103.0	105.4
May	77.5	62.5	117.2	77.3
June	87.7	76.0	102.0	84.7
June	87.8	76.0	102.0	84.7
August	94.3	60.2	108.8	90.8
September	116.4*	62.7	154.4*	87.0
October	136.5	61.0	159.8	76.3

*Revised



N.E.M.A. Index, value of orders for motors (large d.c., polyphase, synchronous) and generators (engine, belt-driven); for transmission and distribution equipment

tors and generators during the first ten months is 90.1, a gain of 38 per cent over the corresponding average for last year, 65.1. The ten-month average for transmission and distribution equipment orders is 118.5, a gain of 42 per cent over the corresponding figure a year ago, 83.5.

•

Dividends Declared by Manufacturers

Square D Co. has declared a dividend of $1 a share on the common stock, compared with 30 cents paid on September 30. Dividends for 1939 will be $1.75 a share, against 75 cents in 1938.

Reliance Electric & Engineering Co. has announced distribution of extra Christmas compensation payments to all employees.

Clark Controller Co. has declared a dividend of 50 cents, increasing the year's payments to 75 cents from 50 cents distributed in 1938.

Among the other manufacturers announcing year-end dividends are the following:

Arrow-Hart & Hegeman, $1 a share on common, increasing the year's payments to $2.15 a share from $1 paid in 1938.

McGraw Electric, extra 75 cents on common. Four regular quarterly dividends of 25 cents each were paid this year, making total disbursements $1.75, compared with $1 paid last year.

•

Orders New Generator

Westinghouse Electric & Manufacturing Co. has received an order from the Northern States Power Co. for a new 9,375-kw. turbine generator. The new unit will be ready for shipment by July 1, 1940, to St. Cloud, Minn. It will operate at 3,600 r.p.m.

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Awarded Pole Contract

Announcement has been made that the L. D. McFarland Co., Sandpoint, Idaho, has been awarded contract for the Western cedar poles to be used on the Raymond-Pe Ell (Wash.) transmission line by the Bonneville Administration.

New York Metal Prices

	Dec. 27, '39 Cents per Pound	Dec. 20, '39 Cents per Pound
Copper, electrolytic	12.50*	12.50*
Lead, A. S. & R. price	5.50	5.50
Antimony	14.00	14.00
Nickel, ingot	35.00	35.00
Zinc, Spot	6.39	6.39
Tin, Straits	49.75	50.50
Aluminum, 99 per cent	20.00	20.00

*Delivered Connecticut Valley.

Field Reports on Business

The electrical industry closes the year with a bright outlook for increased business during the new year. Orders have shown some expansion during recent weeks, with renewed activity anticipated when utility construction budgets get into operation. Appliance sales are due for an uplift in coming months.

NEW YORK

The electrical industry closes 1939 in better shape than in several years. Power production remains at a high level, utility earnings are higher, construction budgets for 1940 are the highest since the record peak, manufacturing plants are working at capacity, with a large backlog of orders which will carry over well into the new year, and prospects for further expansion are bright.

Sales of heavy electrical equipment in 1939 experienced the sharpest gains in recent years, exceeded the 1938 total, and are within 10 to 15 per cent of 1937.

Sales of small electrical appliances were among the best selling Christmas items and distributors reported that December volume would run 25 to 30 per cent ahead of a year ago. Much is being done to inaugurate new drives in 1940 which will lift present volume. The appearance of the 1940 models on the markets will be the tipoff for new campaigns.

Electric utilities are planning large-scale additions to plant capacity to meet growing loads. Merchandising managers are taking the cue to expand their activities. Indications are for a banner appliance year.

While business in the Pittsburgh area declined a little last week evidence is for an upswing after the holidays. Department store sales moved upward. Steel mill activity fell moderately, but is down from the peak only slightly.

PACIFIC COAST

Holiday purchasing throughout the seven Western states averaged about 10 per cent over last year, the additional buying period—early Thanksgiving Day—being somewhat offset by extreme caution exhibited by dealers. Wholesalers report a widespread practice by dealers of ordering in such minimum quantities as were consistent with maximum discounts, necessitating frequent repeats on the same day by the same firm.

REA line construction continues good, particularly in the northwest, and despite official assurances that February will witness its virtual completion in all western sections. Weather conditions will probably delay it until late spring. Outstanding awards include $121,370 for 160 miles in Whitman County, $106,059 for 140 miles in Garfield County, $267,000 for 268 miles in Adams, Franklin and Whitman Counties and $120,306 for 160 miles near Spokane, all in Washington, besides $260,000 for 175 miles in Lincoln, Lane and Polk Counties, $119,500 for 357 miles in Coquille County and $120,000 for 99 miles in Coos County, all in Oregon. New allotments include $326,000 for 292 miles in Stevens County and $250,000 for 189 miles in Lear County.

Power apparatus predominates in recent utility purchasing, including $20,000 control equipment, $5,000 each circuit breakers and cable, all for Imperial Valley irrigation and a Boulder Plant installation including $74,000 for main and auxiliary controls, $5,277 for oscillograph and $5,152 for air cutouts. Approximately $8,000 of thin wall tubing and fittings is needed for the Friant Dam in California.

CHICAGO

On the whole, the level of business activity held steady as the year drew to a close. Although small declines in forward buying were evident, industrial production held at nearly peak levels for the year. The high rate of shipments being made in the face of inventory time is regarded as a favorable factor. The heavy volume of holiday buying continued, with dealers and wholesalers reporting a big demand for electrical toys and appliances. The movement of decorative lighting equipment has been especially good this season.

Manufacturers of electrical equipment report a large volume of shipments carrying to the year end and beyond. Accumulation of orders for heavy equipment will sustain operations well into 1940 at a relatively high rate. One of the most encouraging features is the steadily increasing expansion of facilities by utilities.

Electrical power output rebounded sharply upward from the previous week's decline to show an increase of 15.4 per cent over a year ago. Proposals have been requested on twelve 500-kva. substation transformers and for furnishing new lighting fixtures in the Chicago Tuberculosis Sanitarium. Electrical permits issued last week show considerable activity for additional outlets, new circuits, lights and motors of sizable capacity.

NEW ENGLAND

Business is closing the year with a gratifying record of sales for 1939 and much optimism for a continuing steady volume through the first months of next year. Small motor sales for the past week were in good volume. One lot of 120 motors was bought by a machine tool manufacturer, two lots of fractional motors, one of 300 and another of 800, were sold during the past fortnight and several higher motor ratings ranging from 100 hp. up were placed, according to one prominent distributor.

A Massachusetts utility has added a 1,500-kva. Westinghouse CSP transformer unit and bought switch and control apparatus for installation early in the spring. About $7,500 was involved in small orders for switch and control apparatus recently purchased; local navy yard orders for supplies required for line materials for power service for new shops have been encouraging. B. F. Sturtevant Co., Hyde Park, is engaged on contract for 46 ventilating fans capable of handling over 21,000 tons of air per hour to be installed in New York-Long Island vehicular tunnel. This company also recently obtained a contract for installation of 72 fans supplying about 1,000,000 cu.ft. of air per minute in new modernization plans of department store of G. Fox & Co., Hartford.

Perfects Street Lighting to Overcome Black-out

P. J. Robinson, city electrical engineer of Liverpool, has perfected a form of street lighting which is invisible from a height of 100 ft., but makes walking and driving comparatively safe during the "black-out" period in England. The system consists of the use of small electric bulbs which throw their lights upward on a white painted reflector 20 in. in diameter. From this the light is diffused over an area of road about 45 ft. across. There is no glare or direct light.

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Increased Demand for U.S. Equipment Seen in India

Developments resulting from the war have opened possibilities for increased sales of American electrical supplies in India, a report to the Department of Commerce from American Trade Commissioner B. T. Benson, Calcutta, shows. Two large German firms handling such supplies were recently closed under the Enemy Firms' Act.

At the present time the electrical equipment items in greatest demand in the Indian market are electrically-driven tools. Other electrical equipment products for which an increased demand from Indian importers is looked for include copper wire, motors, conduit and fittings, and controls.

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Ross Dam 30 Feet Higher

Action making it certain that Seattle City Light's Ross Dam at the Skagit will be built 30 ft. higher than was originally intended for the first unit and that the work will go forward uninterrupted was taken by the city council recently. Granting a request by Superintendent E. R. Hoffman, the Council, by unanimous vote, passed an ordinance appropriating $230,000 to carry the dam to the elevation of 1,780 ft. above sea level. City Light will finance the additional construction out of its current operating funds.

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Duke Engineering College

In accordance with a resolution adopted by the board of trustees of Duke University, the division of engineering, which was administered as part of Trinity College, was reorganized into the college of engineering of Duke University. W. H. Hall, professor of civil engineering and chairman of the division of engineering, has been appointed dean of engineering.

SAVE that COPPER WIRE

Reclaim those Shorter Lengths

Splice them Quickly and Securely with *Nicopress* SLEEVES and TOOLS

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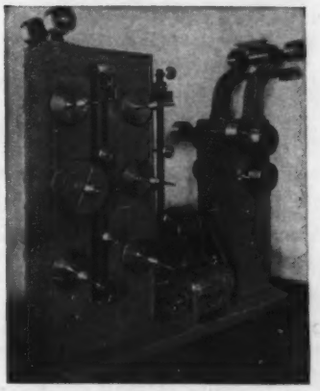

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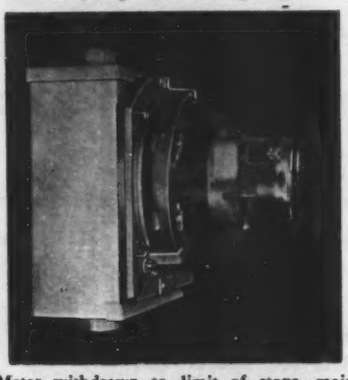

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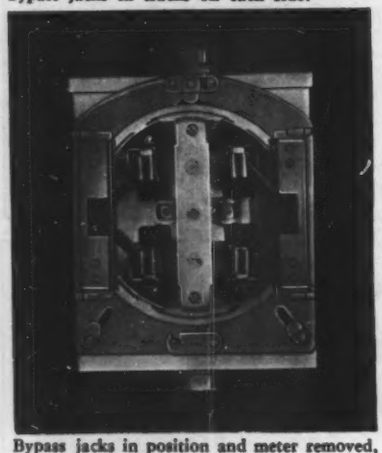

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Municipal Plants

SIKESTON, MO.—City recently lost a third time in the Missouri Supreme Court in its eight-year legal battle to oust from the city the electric distribution system of the Missouri Utilities Co., which has been operating in Sikeston without a franchise in competition with the municipally-owned light and power plant. Division No. 2 of the Supreme Court affirmed a Scott County Circuit Court ruling, which sustained a demurrer to the city's ouster suit, and thereby denied the city's petition for removal of the utility company's wires, poles and other equipment from Sikeston's streets. Supreme Court overruled contentions of the city that there had been a change in the conditions which had caused the Supreme Court in 1932 to deny the city's first ouster petition against the company. The second defeat for the city was suffered in April, 1935, when the Supreme Court affirmed a decision of the Public Service Commission, refusing to hold there was no public necessity for the Missouri Utilities Co. operations in the city. The commission by a three-to-two vote had denied the city's application for an order requiring the company to abandon operations in the city.

BAIRD, TEX.—Resumption of construction on the $165,000 municipal electric light and power plant is expected soon, R. L. Elliott, Jr., city secretary, said. The PWA project was delayed by change of generating plant plans, litigation, and tardiness of the Attorney General's department in approving revenue bonds. Fairbanks, Morse & Co. has the contract. The distribution system has already been completed.

FENNIMORE, WIS.—City Council has voted 6 to 2 to notify the Northern States Power Co. to discontinue service to the city as of November 22, 1940. By that time, the city plans to have completed its Diesel generating plant, estimated to cost approximately $85,000.

PARDEEVILLE, WIS.—Wisconsin Public Service Commission order fixing the price for municipal acquisition of the Pardeeville Electric Light Co. at $25,000 has been approved by Circuit Judge A. C. Hoppmann at Madison. The utility has 60 days in which to appeal to the Supreme Court and if it fails to do so, the village is free to make the purchase.

MEDFORD, WIS.—Circuit Judge A. C. Hoppmann has ruled that the Wisconsin Public Service Commission had erroneously set the value of the Lake Superior District Power Co.'s plant at Medford as of the time the city voted to buy the property. The court remanded the case to the commission for further proceedings and as a consequence the commission must determine the present value of the distributing system.

WHITEHALL, WIS.—Circuit Judge Hoppmann has handed down a ruling permitting the Northern States Power Co. to appeal from a final order of the Wisconsin Public Service Commission, setting a price of $30,000 for which the village could acquire the local electric plant of the company. The only question to be considered in connection with the appeal, as a result of the circuit court ruling, will be the reasonableness of the commission's price.

GRAND COULEE, WASH.—City Council has been faced with the problem of providing a municipal power system for this town, after tabulation of ballots disclosed 237 voters favored city-controlled distribution at a recent election. Only 33 ballots opposed the proposal. Power from Grand Coulee Dam will not be available until July of next year.

•

Recent Rate Changes

INDIANA & MICHIGAN ELECTRIC CO., South Bend, has announced reduction in its residence rates that is expected to save South Bend and vicinity customers approximately $282,000 annually. The new schedule is 5 cents per kilowatt-hour for the first 30 kw.-hr.; 4½ cents per kilowatt-hour for the next 30 kw.-hr.; 2½ cents per kilowatt-hour for the next 240 kw.-hr. and 1½ cents per kilowatt-hour for all excess over 300 kw.-hr. The new rates become effective January 1.

ALABAMA POWER CO. has announced a rate reduction which will result in yearly savings of approximately $387,000 to urban commercial customers. The reduction has been approved by the state Public Service Commission. It becomes effective January 1 and applies to all commercial or general service, other than that used exclusively for "family residential purposes" and that required by large industries filling their entire electric needs from Alabama Power lines. Monthly charges under the new schedule follow: One dollar for the first 20 kw.-hr. or less; 3.5 cents per kilowatt-hour for next 730 kw.-hr.; 2.5 cents per kilowatt-hour for the next 4,250 kw.-hr., and 2 cents per kilowatt-hour for all over 5,000 kw.-hr. The commission added a provision that for "all kilowatt-hours in excess of 150 hours use of the capacity requirements" the following rate should apply: two cents per kilowatt-hour for the next 100 hours use; and 1 cent per kilowatt-hour for all over 250 use hours of the capacity requirements.

GULF POWER CO., Pensacola, Fla., has announced rate reductions to both residential and commercial customers. The new rates are effective January 1. New residential rates are as follows: One dollar for the first 15 kw.-hr. or less; 5 cents per kilowatt-hour for the next 35 kw.-hr.; 3.5 cents per kilowatt-hour for the next 50 kw.-hr.; 2 cents for the next 100 kw.-hr.; 1.25 cents per kilowatt-hour for the next 500 kw.-hr.; 1 cent per kilowatt-hour for all over 700 kw.-hr. This new urban residential rate will apply to all residential customers including those outside urban centers and on rural lines, except in some sparsely populated areas. New commercial rate—One dollar for the first 15 kw.-hr. or less; 5 cents per kilowatt-hour for the next 15 kw.-hr. per 100 watts cap. req.; 2 cents per kilowatt-hour for next 15 kw.-hr. per 100 watts cap. req.; 1.25 cents per kilowatt-hour for next 1,500 kw.-hr.; 1 cent per kilowatt-hour for all kilowatt-hours in excess of the above.

BLUFFTON, IND.—City Council has approved new power rates which will save commercial users of the municipal power plant about $1,565 annually. If approved by the state Public Service Commission the rates will become effective for January power consumption, which is billed in February.

•

Plant Goes in Operation

First lights from the municipally owned $185,000 power plant at Newton Falls, Ohio, were switched on recently by Mayor W. E. Bailey.

Electric Systems Benefit From Weather Forecasting

[*Continued from page 22*]

the United States, capable of adequately fulfilling the varying requirements of business and industry at a cost well within reach of all. We consider this service a specialized supplement to the more general type of forecast to which the United States Weather Bureau is of necessity confined in order to meet within reasonable limits the varied and conflicting demands of a heterogeneous and impersonal public.

In the development of such a forecasting service each new industry confronted the writer with different problems which had to be solved in order that the predictions be of practical value. With a mass of statistical data and a long series of analyzed weather charts available in the files of the meteorological department of the California Institute of Technology the research required in each instance to solve the difficulties was accomplished. Through a slow process of trial and error the design and timing of forecasts producing the optimum value to the consumer with the least amount of extraneous and confusing detail were developed for each type of industry served. In this stage it is necessary to obtain the close co-operation of the client who must fully understand the limits of accuracy and dependability possible through this system of forecasting and make intelligent application of predictions with consideration of these limitations. It has been found that when forecasts are considered in this light their value is greatly enhanced. On the other hand, predictions must be so designed that only the essential weather information is included and this partially interpreted by the meteorologist in the light of the operations of the industry involved.

In conclusion, we may state that:

Weather predictions based upon modern air mass analysis methods may be successfully applied in the electric utility industry to produce economy of operation and to guard against possible weather damage.

To be of value, these predictions must be highly specialized and interpretive and require the close cooperation of the forecasting unit and the consumer if optimum results are to be obtained.

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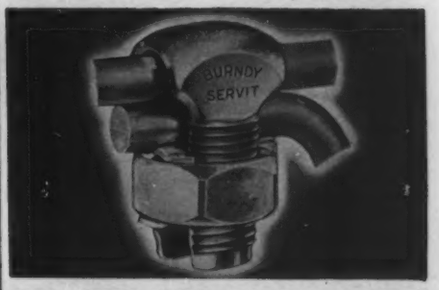

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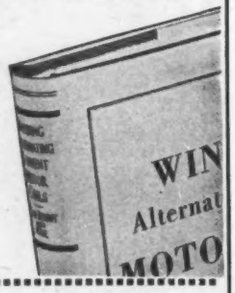

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LETTERS TO THE EDITOR

Large Generating Plant Vs. Moderate Size Station

To the Editor of ELECTRICAL WORLD:

I have been very deeply interested in the "Steam Station Cost Survey," published in the December 2 issue of the ELECTRICAL WORLD and particularly in the comments and conclusions of A. E. Knowlton, your associate editor, in which he states that the trend is now away from large generating plants due to the high efficiencies and economies which it is now possible to obtain with small or moderate size generating stations; that moderately high steam pressures and temperatures appear desirable as compared with excessively high pressures and temperatures; that in general a lot of excessive refinements in the station do not pay, and that the maintenance of the small and moderate size plants is usually less than for the larger plants.

In the light of my own experience, particularly in recent years, I heartily agree with Mr. Knowlton and feel that his conclusions are very soundly drawn.

To Mr. Knowlton's conclusions I should like to add some further thoughts. Why stop at this point? Why not take advantage of the lessons learned by many of the large manufacturing companies engaged in production and distribution of a particular product in this country? Such companies when they reach the reasonable limit of economical production in any factory, instead of further adding to their producing capacity in that factory, construct a new manufacturing plant which is located advantageously with regard to their distributing system. Following Mr. Knowlton's conclusions above mentioned I would suggest, therefore, that managements of power companies should not install excessive generating capacity in one location, but when increased producing capacity is required should rather give careful thought to the advisability of constructing a new moderate size generating station located as advantageously as possible with regard to the system load.

Such a policy should open a way toward greater economy of operation which, I feel, has not yet been given very deep consideration. The smaller generating stations if designed simply without undue refinements (as pointed out by Mr. Knowlton) should result in a lower investment cost per kilowatt of production plant. Furthermore, if the locations of such plants are wisely chosen there should be a very marked reduction in the investment required in distributing system (which is usually very large) as well as in the cost of maintenance and operation of such distributing systems. Full use of reserve production capacity could readily be obtained by simple interconnections.

Furthermore, the development of a power system on this basis should considerably improve the opportunities for the profitable sale of the by-products of the production plants—namely, steam and hot water for industrial purposes.

ARTHUR L. NELSON, Engineer
Park Square Building,
31 St. James Avenue,
Boston, Mass.

•

Short-Circuit Kva. a Consideration

To the Editor of ELECTRICAL WORLD:

In the ELECTRICAL WORLD dated November 4, 1939, page 38, under "Distribution Planning III," C. E. Arvidson says: "In general, these two limiting factors (*i.e.*, voltage drop and thermal ability) determine the minimum conductor size which may be used on feeders." I would like to suggest that the available short-circuit kva. be considered also, as a distribution line from a main substation would carry a large kva. value in the event of a short circuit developing on it, and if the wire size happened to be based on the load rather than fault current a longer outage might prevail. "Thermal ability" would cover this condition.

H. WILSON,
Purchasing Agent,
Carolina Power & Light Co.,
Raleigh, N. C.

•

Why Short-Circuit Current Is Disregarded

To the Editor of ELECTRICAL WORLD:

I agree with Mr. Wilson in that the available short-circuit current should be considered in determining the minimum feeder conductor size on unregulated circuits served from large capacity substations, since the feeder might burn off during a short circuit before the breaker can operate. In general, however, the short-circuit current can be disregarded on regulated circuits provided the maximum short-circuit current is limited to about 25 times the rating of the circuit regulator as recommended by the induction regulator manufacturers. Proper settings of circuit relays should then insure breaker operation for any fault on the

circuit before the feeder can anneal or burn off.

There may be some instances of smaller conductor in the mains or laterals beyond the feeder where the maximum short-circuit current would be less than the "pick-up" current on the breaker relays but greater than the thermal ability of the smaller primary conductor. In such cases the breaker would not operate and the primary conductor may anneal. Such cases can be protected by primary fuses located in the mains or laterals as required.

C. E. Arvidson,
Commonwealth & Southern Corp.,
Jackson, Mich.

•

Calculation Time Shortened by Six Hours

To the Editor of Electrical World:

After reading C. E. Arvidson's article on "Calculating Overhead Primaries" (Electrical World, October 7, 1939), it took me just two hours to work out, from a primary map on hand, a complete layout sketch and voltage calculations for a 2,300-volt, three-phase, 100-amp. primary circuit, using the author's method. Quite some time ago I worked on this same circuit using detailed methods of calculation, and it took me a whole day to obtain my results. I find the results of my new calculation just as serviceable as those of the former one. Many thanks to Mr. Arvidson for saving me at least six hours of work for every primary circuit I have to calculate.

Edgardo Ledesma,
Electrical Department
A. S. Diaz Electric Service,
City of Bacolod,
Negros Occidental, Philippines.

Consider Postponement of Uniform Rate Order

The effective date of the Pennsylvania Public Utility Commission's uniform rate order to the Pennsylvania Power & Light Co. may be deferred for several months at least in order to permit adjustments of present rates for small business concerns, it was announced at a recent conference between company officials and the commission.

John S. Wise, Jr., president of the utility; N. G. Reinicker, vice-president and general manager, and T. J. Perkins, general counsel, represented the company. Commissioner Richard J. Beamish said the conference had been called to prevent, if possible, increases the first of the year for thousands of small business companies.

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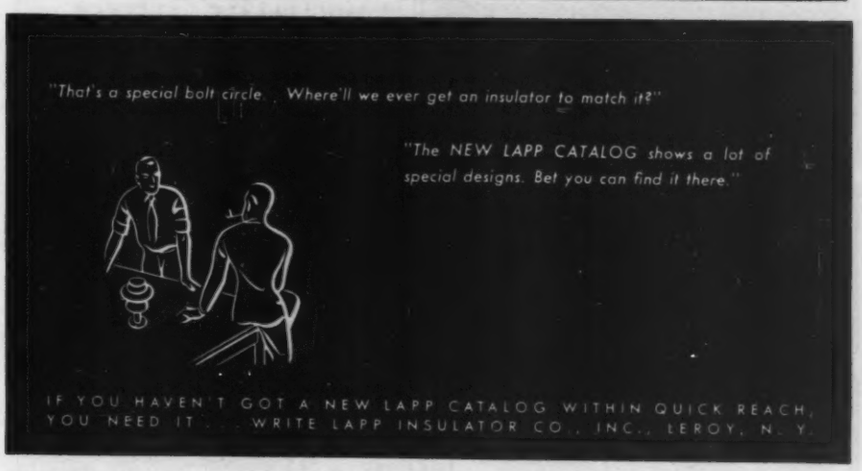
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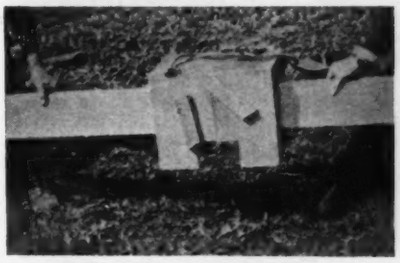
Read
Getting Along With People
by Milton Wright

Wood for Hot Line Protection

[*Continued from page 24*]

a single piece of redwood, free from knots and pitch streaks. The end pieces for engagement under the inverted V openings in the ends of the insulator box and the cleats for reception of the lifting tool—a pole with a flat V-shaped piece of wood on the end—are of maple, as are also the rope holders and the lifting cleats on the insulator hood. The protectors are given two coats of insulating varnish and are tested at 27,500 volts. Cost of three boxes and six troughs is about $64.

The troughs and hoods are kept in heavy canvas coverings when not in use. To apply the troughs and hoods the lineman stands at a convenient distance down on the pole and sets them over the conductor and insulator with the lifting tool. Then the hood ropes are lashed under the crossarms as shown in the illustration. The linemen trust these protectors, feel safe when wires are covered with them. They are convenient to handle, since they do not require the wearing of rubber gloves while they are being set in place. As a matter of fact, some of the men use these protectors in preference to the standard rubber coverings on lower voltage lines because they find them easier to handle. Also, the troughs have been used to cover up buses in stations when men are working above.



Cleats on trough lock with box covering insulator. Note rope for tying box to cross arm

•

High in Power Use

Average residential consumption of South Carolina Power Co. reached an all-time high of 1,389 kw.-hr. on September 30, as against 1,177 kw.-hr. for the year ended September 30, 1937. The average rate has been reduced from 3.61 to 3.24 cents.

Cost Trends Favor Purchased Energy

[*Continued from page 23*]

prices reported by the same agency. In the bureau's published series designated as "composite prices" for electrical energy, recent figures are not on the same basis as earlier ones. Comparable figures for the entire period have been made available through the courtesy of the bureau. The series represents the average price per kilowatt-hours of retail and wholesale commercial sales combined.

Receipts of the federal government, representing essentially taxes, are from the "Statistical Abstract" except for 1938, which is quoted from the U. S. Treasury Department by the National Research Bureau, Inc.

Capitalizing on Complaints to Improve Service

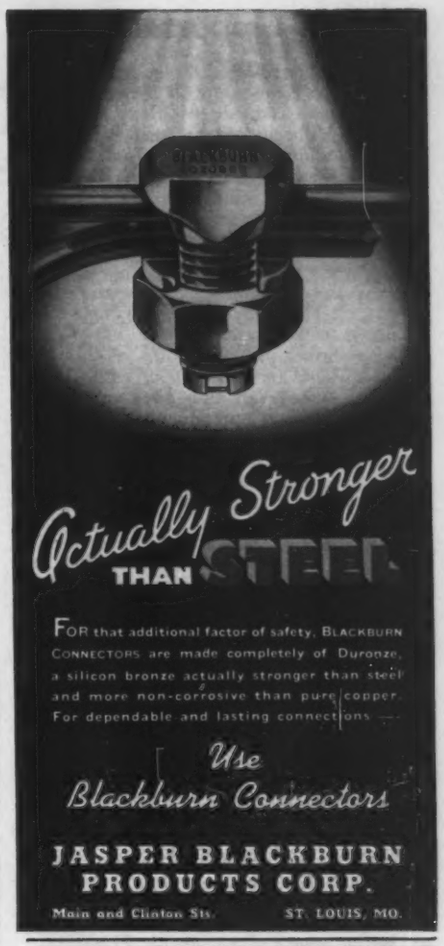
[*Continued from page 35*]

company committee which meets weekly to co-ordinate the service activities of the four companies in northern Illinois now using the plan. This committee compares complaints between companies and lays broad policy plans.

Service Department

For those who object to the committee method of supervision, there is always the possibility of using a "service department" for handling all complaints. That method has merit, first, because it provides a control clearing house for all kinds of difficulties with customers, and, second, because it relieves operating departments from the additional burden of handling their own complaints—advantageous when more than one department becomes involved in a complaint from the same customer. Such a separate department might also have an additional appeal to customers because they will always deal with the company through a single channel and acquire the pleasant reaction of having a "friend at court."

However, the complaint idea will operate under any given set of conditions and what we are advocating is merely the application of some form of good accounting practice which will allow complaints to be capitalized for the good of the customer, the good of the industry and the future of the nation.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Sales Opportunities

LINCOLN, NEB.—Iowa-Nebraska Light & Power Co., Lincoln, plans extensions in transmission and distributing lines in parts of Mills and Montgomery Counties, Iowa, totaling about 19 miles, for expansion in rural electric system. Also will extend lines for similar service in parts of Taylor and Fremont Counties, Iowa. Permission has been secured.

LOS ANGELES, CALIF.—Los Angeles Water and Power Bureau, 205 South Broadway, has plans under way for new distribution power substation at 123 South Indiana Street, to be known as Station No. 23. Cost about $415,000, with transformers, switchgear and auxiliary apparatus, of which approximately $265,000 will be expended for equipment. Plans also are nearing completion for new load dispatchers' headquarters building at First and Boylston Streets, estimated to cost about $185,000, with equipment. Work has been started on new underground headquarters building at last noted location, to cost about $520,000, including equipment.

AUSTIN, TEX.—Lower Colorado River Authority, Littlefield Building, Austin, Fritz Englehard, chairman, receives bids until January 5 for construction of power plant and appurtenant structures at Marshall Ford power development.

BUFFALO, N. Y.—Hambleton Terminal Corp., River Road, Tonawanda, Buffalo, plans installation of motors and controls, electric pumping machinery, regulators, conveyors and other equipment in new gasoline refining plant on local site, comprising several units equipped for capacity for handling about 5000 barrels of crude oil per day. Work is scheduled to begin soon. Cost about $1,400,000. George K. Hambleton is president.

NORTH PLATTE, NEB.—City Council has negotiations under way for purchase of local transmission and distributing lines of Northwestern Public Service Co., Huron, S. D., and will operate as a municipal system in future. Extensions and improvements are planned, including power substation facilities.

ELYRIA, OHIO—Ohio Public Service Co., Cleveland, Ohio, has plans under way for new outdoor type power substation at Elyria, where site is being selected.

DUBUQUE, IOWA—Central States Power & Light Corp., Dubuque, plans extensions in transmission lines in part of Fayette County. Application has been made for permission. Company also will make similar line extensions in part of Chickasaw County, for which authority recently was granted.

SCOTTSBORO, ALA.—City Council is concluding arrangements for purchase of local electrical distribution system of Alabama Power Company, Birmingham, Ala., and will operate as municipal property in future. Extensions and improvements are planned, including installation of power substation facilities.

WATERLOO, IOWA—Waterloo, Cedar Falls & Northern Railroad, Waterloo, has awarded contract to Currie-Wildes Construction Company, 533 Park Road, Waterloo, for erection of new power substations in Waterloo; Laporte City, Iowa, and other points, including addition to power stations at Farmer, Waverly, Urbana and Robins, Iowa, for feeder service for electric railway system, recently referred to in these columns. Each new unit will be of indoor type, one-story and basement, about 17x27 feet. Transformers and other equipment will be installed by company forces as soon as structures are ready. Extensions will be made in 300-volt power lines at Waterloo. Complete project will cost $235,000.

DENVER, COLO.—Bureau of Reclamation, Denver, receives bids until January 8 for three 30,000-kva., 6900-volt, three-phase, 60-cycle, vertical shaft a.c. generator units for Parker power plant, Parker Dam power project, Arizona-California. Equipment will be installed by Government (Specifications 888). Also, until January 4 for power transformers, metering transformers, switching and metering unit, step-voltage regulators, high-voltage air-break switches, high-voltage expulsion fuses, low-voltage air-break and disconnecting switches, station-type lightning arresters, distribution-type lightning arresters, and one oil circuit breaker for Wiggins, Brush and Fort Morgan power substations, Colorado-Big Thompson project, Colo. All equipment will be installed by Government.

SAN DIEGO, CALIF.—Consolidated Aircraft Corp., San Diego, plans installation of motors and controls, electric hoists, conveyors and other equipment in new plant additions for parts production and assembling. Entire project will cost close to $1,000,000. Edward G. and Ellis W. Taylor, 803 West Third Street, Los Angeles, Calif., are architects.

MERRILLAN, WIS.—Village Council has plans under way for municipal hydroelectric power plant to replace present station, which heretofore it has been proposed to rebuild and modernize. Bids received on previous call for latter work were rejected a number of weeks ago. A site for new plant is now being selected. Surveys and estimates of cost are being made by L. A. DeGuere, Wisconsin Rapids, Wis., consulting engineer.

TRUMANN, ARK.—Arkansas Power & Light Co., Pine Bluff, Ark., has concluded arrangements for purchase of properties of Trumann Light & Power Co., and will furnish service at Truman in future. Transfer has been approved by State Utilities Commission. Plans are under way for early construction of new 33,000-volt transmission line from company station at Marked Tree, Ark., to Trumann for power supply. Present distributing substation at latter place will be enlarged and modernized, with installation of additional equipment.

HOUSTON, TEX.—Sinclair Refining Co., Gulf Building, Houston, plans installation of motors and controls, transformers and accessories, conveyors, electric-operated pumping machinery and other equipment in connection with modernization and expansion of oil refining plant on Houston ship channel. Proposed to carry out work in 1940. Cost reported close to $4,000,000. Executive offices of company are at 630 Fifth Avenue, New York, N. Y.

JACKSONVILLE, FLA.—City Commission plans early installation of new white way street-lighting system along boardwalk at Jacksonville Beach. Financing has been arranged through Federal aid.

CEDAR RAPIDS, IOWA — Iowa Electric Light & Power Co., Cedar Rapids, plans extensions in transmission lines in part of Boone County, for expansion in rural electric system. Proposed to begin work soon. Application has been made for permission.

BAYONNE, N. J.—Electric Boat Co., 40 Wall Street, New York, N. Y., plans installation of motors and controls, switchgear, electric hoists, cranes, conveyors and other equipment in new shipyard, adjoining present plant of Electro Dynamic Works, foot of North Street, Bayonne, fronting on Newark Bay, an affiliated interest. New yard will be used for building of motor torpedo boats and submarine chasers for United States Navy. Cost reported over $500,000. Work is scheduled to begin soon.

OMAHA, NEB. — Nebraska Power Co., Omaha, will make extensions in transmission line in part of Dodge County for rural electric service. Work will be carried out at early date. Permission has been secured.

OXFORD, OHIO — Board of Trustees, Miami University, will take bids at once for extensions and improvements in power plant on campus, including installation of additional equipment. Fosdick & Hilmer, Union Trust Building, Cincinnati, Ohio, are consulting engineers.

TWIN FALLS, IDAHO—Idaho Power Co., Boise, has preliminary surveys under way for suitable site for proposed hydroelectric power plant in the Snake River Canyon, vicinity of Filer and Buhl, Idaho. Company has filed on three potential power sites in that area, and will determine exact locality for development in near future.

WEBSTER CITY, IOWA—City Council plans extensions in primary and secondary lines in Hamilton County for rural electric system, including service facilities. Permission has been asked.

•

Electric Output Up 8.3% in Britain

The United Kingdom's electricity production reached the record level of 25,284,000,000 units during the year ended March 31 last, according to the annual report of the Electricity Commission just published in London. The total output was 1,938,000,000 units higher than in the previous year, a rise of 8.3 per cent.

At the end of March the number of authorized undertakings was 581, a decrease of ten under the preceding year. This reduction was mainly attributable to the acquisition by the Shropshire, Worcestershire and Staffordshire Power Co., controlled by Edmundsons Electricity Corp., of the undertakings of a number of subsidiary or associated companies and the vesting of certain municipal authority undertakings in other municipal authorities.

•

Ontario Primary Load Up

Ontario Hydro-Electric Power Commission reports primary load for all systems in October at 1,669,337 hp., against 1,484,615 hp. last year, an increase of 12.4 per cent. Primary and secondary loads for all systems totaled 1,963,471 hp., against 1,831,216 hp. last year, an increase of 7.2 per cent.

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1—150-kw., 250-V., Westinghouse, Synchronous.
2—100-kw., 125-V., G.E., Sq. Cage.
1—100-kw., 250-V., Synchronous.
1— 75-kw., 125-V., Crocker-Wheeler. Synchronous.
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1— 40-kw., 125-V., Westinghouse, Synchronous.

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1—500-kw., G.E., 3600 R.P.M., direct connected exciter, generator only.
1—400-kva., General Electric, non-condensing.
1—156-kva., Westinghouse, non-condensing.
2—100-kw., Westinghouse, 3 phase, 60 cycle, 220 volt, non-condensing.
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1—62½-kva., Allis Chalmers-Kerr, 220 volt, 3 phase, 60 cycle, non-condensing.

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4—250-kva., Moloney, 7800/220/440 volts.
4—200-kva., Pittsburgh, 7800/230/110 volts.
2—200-kva., General Electric 2300/220-440 volts.
3—200-kva., General Electric, 13,800/230/460 v.
3—150-kva., Pittsburgh, 6600/440 volts.
2—150-kva., West. 2300/330/115-V, Scott Taps.
3—150-kva., General Electric, 33,000/2300 volts.
3—150-kva., General Electric, 2200/240-440 volts.
6—100-kva., Wagner, 2200/220-110 volts.
2— 50-kva., Kuhlman, 2200/110-220 volts.
3— 50-kva., Moloney, 2200-220/440 volts.
5— 25-kva., Westinghouse Air Cooler, 440/220/220/110-V.
1— 25-kva., G.E., 440/110-V.
1— 25-kva., G.E. 220/220/110-V.

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1	720	514	13,200/6600	G.E. Syn.
1	500	450	2300/4000	G.E. Sl. Rg.
1	400	514	440	West. Sl. Rg.
1	350	450	440	G.E. Sl. Rg.
1	350	300	440	G.E. Sl. Rg.
1	350	100	220	G.E. Syn.
1	300	600	2200	G.E. Sl. Rg.
1	300	720		G.E. Sl. Rg.
1	240	720	2200	G.E. Syn.
4	200	450	2200/4000	G.E. Sl. Rg.

Variable Speed 230 Volt Motors

H.P.	R.P.M.	Type
1—150	300/900	Westinghouse
100	475/1200	Electro Dyn.
90	470/940	G.E.
75	235/950	Burke
35	500/1500	G.E.
35	500/1250	G.E.
30	600/1200	West.
30	225/900	Cr. Wheeler
25	300/1200	G.E.
20	750/1500	G.E.
20	400/1200	G.E.
4— 20	400/1200	G.E.
3— 15	300/1200	G.E.

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U. S. GOVERNMENT

TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENNESSEE. Sealed bids, in duplicate, will be received until 10:00 A.M., Central Standard Time, January 4, 1940, and then publicly opened, for *designing and furnishing 30,000 KVA Synchronous Condenser* for Columbia Primary Substation. Bidding Documents, for which there is no charge, available December 14, 1939, at above office. C. H. Garity, Director of Purchases. (66)

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American Insulating Machinery Co. 77
*American Steel & Wire Co..... 12
*Anchor Mfg. Co..... 78

Baehr, William A..... 82
Barker & Wheeler..... 82
Black & Veatch..... 82
*Blackburn Products Corp., Jasper 83
*Burndy Engineering Co.....79, 81

Cheney & Foster..... 82
*Continental-Diamond Fibre Co... 53
Cooper & Co., Hugh L..... 82
*Cornell-Dubilier Electric Corp.... 60

Day & Zimmermann..... 82
Directory of Engineers..... 82

Electric Auto Parker Corp..... 65
*Electrical Testing Laboratories.... 82
Engineers, Directory of..... 82

Ferranti Electric, Inc..... 77
*Fibre Conduit Company..... 73
Foley, Robert E..... 82
Ford, Bacon & Davis, Inc..... 82
Fowle & Co., Frank F..... 82

G & W Electric Specialty Co..... 5
*General Electric Co....18, 47, 49, 51
General Radio Company..... 11
Gulf Oil Corp..... 8

*Hazard Insulated Wire Works.... 4
Hoosier Engrg. Co..... 82
*Hubbard & Co..... 67

*I-T-E Circuit Breaker Co..Third Cover
*Imperial Porcelain Works..... 83

Kearney Corp., James R..... 59
*Kuhlman Electric Company
Back Cover

Lapp Insulator Co.....9, 77
Leffler, William S..... 82

Manning and Co., J. H..... 82
McGraw-Hill Book Co..... 80
Mead, Daniel W..... 82
Metropolitan Device Corp.
Second Cover
*Moloney Electric Co..... 57
Mullergren, Arthur L..... 82

*National Telephone Supply Co... 77

Ohio Brass Co..... 6
*Okonite Co. 4
*Okonite-Callender Cable Co..... 4

Railway & Industrial Engineering
Co. 63
Recording & Statistical Corp..... 82
*Reliable Electric Co..... 70
Rome Cable Corp..... 79

Sanderson & Porter..... 82
Sangamo Electric Co..... 7
Sargent & Lundy..... 82
Scheidenhelm, F. W..... 82
Searchlight Section 85
Simplex Wire & Cable Co..... 54
Slater Electric & Mfg. Co., Inc.... 79
Spooner & Merrill, Inc..... 82
Stevens & Wood, Inc..... 82
Stone & Webster Engrg. Corp..... 82

*United States Steel Corp..... 12

*Wagner Electric Corp..... 10
*Westinghouse Electric & Mfg. Co.
13, 16, 17
White Engrg. Corp., J. G..... 82

■

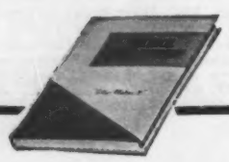
PROFESSIONAL SERVICES..... 82

■

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT SERVICE 85
POSITIONS VACANT 85
POSITIONS WANTED 85
SELLING OPPORTUNITIES 85
USED AND SURPLUS EQUIPMENT..... 85
Belyea Co., Inc..... 85
Chicago Electric Co..... 85
Duquesne Electric & Mfg. Co..... 85
Ebasco Services Inc..... 85
Electric Service Co., The..... 85
Hemphill & Co., J. L..... 85
Industrial Equipment Co..... 85
Kirk Co., Inc., Wallace E..... 85



★ These companies have supplied additional buying information on their products in the 1939 edition of the Electrical Buyers' Reference, published by Electrical World

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